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DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, AND CERTAIN INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1985

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

UNITED STATES SENATE

NINETY-EIGHTH CONGRESS

SECOND SESSION

ON

H.R. 5713

AN ACT MAKING APPROPRIATIONS FOR THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, AND FOR SUNDRY INDEPENDENT AGENCIES, BOARDS, COMMISSIONS, CORPORATIONS, AND OFFICES FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1985, AND FOR OTHER PURPOSES

PART 2—(Pages 803-1678)

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL HOME LOAN BANK BOARD
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NATIONAL SCIENCE FOUNDATION
OFFICE OF TECHNOLOGY ASSESSMENT

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DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1985

THURSDAY, MARCH 1, 1984

U.S. SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 10 a.m., in room SD–124, Dirksen Senate Office Building, Hon. Jake Garn (chairman) presiding.

Present: Senator Garn.

NATIONAL SCIENCE FOUNDATION

STATEMENT OF EDWARD A. KNAPP, DIRECTOR

ACCOMPANIED BY:

- MARY L. GOOD, VICE CHAIRMAN, NATIONAL SCIENCE BOARD
- CARL W. HALL, ACTING ASSISTANT DIRECTOR, ENGINEERING
- RICHARD J. GREEN, ASSISTANT DIRECTOR, SCIENTIFIC, TECHNICAL, AND INTERNATIONAL AFFAIRS
- ROBERT RABIN, ACTING ASSISTANT DIRECTOR, BIOLOGICAL, BEHAVIORAL, AND SOCIAL SCIENCES DIRECTORATE
- ALBERT L. BRIDGEWATER, ACTING ASSISTANT DIRECTOR, ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES
- MARCEL BARDON, ACTING ASSISTANT DIRECTOR, MATHEMATICAL AND PHYSICAL SCIENCES
- LAURA P. BAUTZ, ACTING ASSISTANT DIRECTOR, SCIENCE AND ENGINEERING EDUCATION
- THOMAS UBOIS, ASSISTANT DIRECTOR, ADMINISTRATION
- RICHARD S. NICHOLSON, STAFF DIRECTOR
- BERTHA SALSBURG, SPECIAL ASSISTANT TO DIRECTOR
- MARGARET L. WINDUS, EXECUTIVE OFFICER, NATIONAL SCIENCE BOARD
- EDWARD F. HAYES, CONTROLLER
- RAYMOND E. BYE, JR., DIRECTOR, OFFICE OF LEGISLATIVE AND PUBLIC AFFAIRS
- CHARLES H. HERZ, GENERAL COUNSEL

OPENING REMARKS

Senator GARN. The subcommittee will come to order.

The National Science Foundation is the principal Federal agency for the support of basic research across all fields of science. NSF accounts for about 24 percent of all Federal support for basic research going to academic institutions. About 2,000 colleges, universities, industrial firms, and other organizations participate in NSF programs through over 12,000 grant awards.

BUDGET REQUEST

For fiscal year 1985, you are requesting $1,501,792,000. This represents an increase of $180,481,000, which is the net effect of an increase of $167,257,000 in research and related activities, an increase of $12,624,000 in the Antarctic program, an increase of $700,000 in science education, and a decrease of $100,000 in your special foreign currency program.

Dr. Knapp, I am pleased to have you here for your second appearance before this committee. You are in an enviable position of directing the Foundation during a period when its research budget has increased by 33 percent. This is an indication of the priority placed on science and technology by the President.

I might add that during the time I have been chairman of this subcommittee, NSF's research budget has been increased by $520 million, or 57.4 percent.

I might just add that certainly it was an interesting experience for me to go to Antarctica in December to view the programs that are going on there personally. I have been accused of going on a junket and going south for the winter. [Laughter.]

I have pleaded guilty to that, but I told them I went a little bit too far south as far as any sunshine and warm weather. Although it was warm at the South Pole, they told me, for normal times, it was only 39 degrees below zero the day we were there. I must admit in Utah in January we had a minus 61. So we were much colder than Antarctica. [Laughter.]

But it really was a very interesting experience. I plead guilty to the fact that I didn't stay long enough. That was my fault. The Foundation recommended I stay for 5 days. We only scheduled 3. I must admit the Foundation was correct and I was wrong.

We hated to leave. It was a very fascinating experience, and I hope sometime in the future to find the time, which is difficult, to go back and take an even closer look at what you are doing there.

Please proceed with your summary of your statement.

Dr. KNAPP. Thank you, Mr. Chairman.

I would like to say that the subcommittee's support of the NSF research budget, which, as you noted, is up 57 percent during your chairmanship, is even more pronounced when one sees that during this same period the total HUD-Independent Agencies appropriations bill has declined by over 50 percent in constant dollars. This is proof of the importance you and the subcommittee attach to basic research.

I wish to personally and publicly thank you for your support and look forward to your continued support with this year's budget request. We will strive to use this public money prudently and effectively.

PREPARED STATEMENT

With your permission, I would like to submit a detailed statement of our budget request for the record.

[The statement follows:]

STATEMENT OF DR. EDWARD A. KNAPP

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I APPRECIATE THE OPPORTUNITY TO APPEAR BEFORE THE COMMITTEE THIS MORNING TO DISCUSS THE ADMINISTRATION'S FY 1985 BUDGET REQUEST FOR THE NATIONAL SCIENCE FOUNDATION.

WITH ME THIS MORNING IS DR. MARY L. GOOD, VICE-CHAIRMAN OF THE NATIONAL SCIENCE BOARD AND VICE PRESIDENT AND DIRECTOR OF RESEARCH AT U. O. P. INC. AFTER MY BRIEF OVERVIEW OF THE FOUNDATION AND ITS PLANNED PROGRAM FOR FY 1985, DR. GOOD WILL DESCRIBE THE ROLE OF THE NATIONAL SCIENCE BOARD IN ESTABLISHING OUR PRIORITIES AND PROGRAMS.

WHEN SHE HAS FINISHED, I WILL THEN DESCRIBE OUR BUDGET REQUEST IN MORE DETAIL, HIGH-LIGHTING THREE INITIATIVES WE ARE PROPOSING IN FY 1985: (1) THE BEGINNING OF CONSTRUCTION ON THE VERY LONG BASELINE ARRAY, (VLBA); (2) AN EXPANSION OF SUPPORT OF COMPUTER NETWORKING AND RESEARCH TIME ON SO-CALLED "SUPER-COMPUTERS," AND (3) A NEW PROGRAM TO ESTABLISH CROSS-DISCIPLINARY RESEARCH CENTERS IN ENGINEERING. I WILL CONCLUDE MY PRESENTATION WITH A BRIEF DISCUSSION OF A TOPIC THAT I KNOW IS OF PARTICULAR INTEREST TO THIS COMMITTEE: THE STATUS OF OUR PLANS FOR PRE-COLLEGE SCIENCE AND ENGINEERING EDUCATION.

THE FY 1985 REQUEST: AN OVERVIEW

MR. CHAIRMAN, OUR BUDGET REQUEST FOR FY 1985 IS $1.5 BILLION, AN INCREASE OF 13.6 PERCENT ABOVE FY 1984. THIS TOTAL INCLUDES $1.3 BILLION FOR OUR RESEARCH AND RELATED ACTIVITIES; $76 MILLION FOR SCIENCE AND ENGINEERING EDUCATION; $115 MILLION FOR THE U.S. ANTARCTIC PROGRAM AND $2.8 MILLION FOR FOREIGN CURRENCY.

THIS PROPOSED BUDGET REFLECTS THE ADMINISTRATION'S DEEP COMMITMENT TO EXCELLENCE IN OUR COUNTRY'S PURSUIT OF SCIENTIFIC AND TECHNOLOGICAL ACHIEVEMENTS AND TO THE TRAINING OF OUR FUTURE SCIENTISTS AND ENGINEERS. IT ALSO REFLECTS THE VERY STRONG SUPPORT WHICH THE FOUNDATION'S PROGRAMS RECEIVED FROM THIS COMMITTEE AND THE CONGRESS LAST YEAR.

AS YOU KNOW, MR. CHAIRMAN, THE NSF PLAYS A BROAD, IMPORTANT ROLE IN SUPPORT OF BASIC RESEARCH IN THE MATHEMATICAL, PHYSICAL, GEOPHYSICAL, BIOLOGICAL, SOCIAL, AND BEHAVIORAL SCIENCES AND ENGINEERING. THIS BASIC RESEARCH IS THE FOUNDATION FOR THE NATION'S LONG-TERM SCIENTIFIC AND TECHNOLOGICAL STRENGTH. OUR CONTINUED ECONOMIC COMPETITIVENESS AND FUTURE TECHNOLOGICAL INNOVATIONS DEPEND VERY MUCH ON THE STRENGTH OF THIS FOUNDATION.

THE NSF PROVIDES OVER 90 PERCENT OF THE SUPPORT FOR BASIC ACADEMIC RESEARCH IN IMPORTANT BRANCHES OF SEVERAL SCIENCES SUCH AS PURE MATHEMATICS AND ANTHROPOLOGY. IN SOME OF THE GEOPHYSICAL SCIENCES, WE SUPPORT ALMOST THREE-FOURTHS OF THE FUNDAMENTAL WORK. EVEN IN FIELDS LIKE CHEMISTRY AND ELECTRICAL ENGINEERING WE FUND ONE-THIRD OF ALL ACADEMIC RESEARCH.

I KNOW THAT THIS COMMITTEE IS INTERESTED IN THE NUMBER OF SCIENTISTS AND ENGINEERS THE FOUNDATION SUPPORTS IN THESE DIVERSE DISCIPLINES. WE ESTIMATE THAT IN FY 1985 A LITTLE MORE THAN 14,000 SENIOR SCIENTISTS AND ENGINEERS IN THE UNITED STATES WILL RECEIVE DIRECT SUPPORT THROUGH NSF AWARDS. BUT THIS IS ONLY THE "TIP OF THE ICEBERG."

FOR THE FOURTH YEAR IN A ROW WE ARE PLACING A HIGH PRIORITY ON SCIENTIFIC RESEARCH INSTRUMENTATION AS PART OF OUR BUDGET REQUEST. WE ESTIMATE THAT TOTAL SUPPORT OF INSTRUMENTATION AND FACILITIES WILL REACH $237.0 MILLION, AN INCREASE OF 20.3 PERCENT OVER FY 1984.

Instrumentation is expensive. It tends to be the first thing which is cut or postponed when budgets are reduced. Yet it is absolutely critical to the conduct of leading-edge research in virtually every field of science and engineering. There is evidence that we, as a Nation, may be underinvesting in equipment and research facilities. For this reason, as you know, much of the increase in the Foundation's budget for the past three years has gone into expanded support for instrumentation.

The dollars which NSF puts into instruments and facilities have a very significant "multiplier effect." They benefit many more scientists, engineers, and graduate students than just those receiving direct support through grants.

For example, in FY 1985 the Foundation proposes to invest almost $65.0 million in its five national astronomy centers. We estimate that nearly 2,000 astronomers use these centers, though only about one-third will be NSF grantees. Our Materials Research Laboratories (MRLs) typically provide facilities for faculty and students well beyond those receiving direct program support. At Stanford University in 1983, for example, 76 faculty members were involved in materials-related research, though less than half were directly supported by the NSF program. Similarly, at the University of Illinois MRL, there were 100 senior scientists and engineers engaged in materials research in 1983, only about one-fourth of them NSF grantees. Or, to take still another example, we currently support 12 industry-university cooperative research centers which operate with 120 faculty members, 18 postdoctorals, 195 graduate students and 29 undergraduates. Only a small fraction are directly funded by the NSF. Indeed, since 1972 when this program was started, the Foundation's $11.0 million total investment has been supplemented with over $25.0 million in matching funds from industry and state government.

Nor are academic scientists the only ones who benefit from the "multiplier effect" of investments in instrumentation and facilities. We support the Small Angle Scattering Facility at Oak Ridge National Laboratory. In 1983, 75 investigators, including 25 graduate students, carried out some of their work at Oak Ridge. Over 40 percent of these scientists were affiliated with industrial or governmental laboratories. A similar situation exists in our Regional Instrumentation Facilities. These centers were initiated in 1978 to give scientists access to expensive, sophisticated, specialized instrumentation. Users, like the 147 investigators who carried out work at the MIT Laser Spectroscopy and Dynamics Center in 1983, have come from industry and governmental laboratories as well as the academic community. Only some of them are NSF grantees.

There is another very important way in which the Foundation's investment in research has a "multiplier effect," giving us even more for our money. In the United States, our colleges and universities teach graduate and undergraduate students and are the primary performers of basic research. Many students have an opportunity to get direct, hands-on research experience as Research Assistants; students benefit when their professors work at the cutting-edge of knowledge through research activities. Thus, an NSF dollar works doubly hard: it supports fundamental research while contributing to the quality of our country's skilled manpower base.

In our FY 1985 Request we will be supporting over 11,000 graduate students on NSF grants for a total of $103 million. This is an increase of 16 percent over FY 1984. Similarly, our support of research at the Nation's predominantly undergraduate institutions will increase by 15 percent in FY 1985 to over $42 million. These institutions provide undergraduate training for a significant fraction of our future scientists and engineers.

There will be 550 new NSF graduate fellowships next year for a total of approximately 1,550. The annual stipend will be increased from $8,100 to $9,000. And finally, we will be supporting an additional 200 young scientists and engineers through the Presidential Young Investigator awards program bringing the total to 400 in FY 1985. With matching funds from industry, these awards are intended to encourage promising young people to remain in academic careers to train future generations of scientists and engineers.

In these and other ways then, NSF activities contribute directly to the quality of education in our colleges and universities. Indeed, Mr. Chairman, I would like to leave you with the thought that virtually our entire budget has a significant impact on the quality of science and engineering education in this country!

At this point, let me introduce Dr. Good who will describe the important role which the National Science Board has played in our budget process. During the past year the Board has worked with me, the Foundation staff, many of our advisory groups, and the National Academies of Sciences and Engineering to help shape the priorities you see expressed in our request.

Dr. Good

VERY LONG BASELINE ARRAY (VLBA)

Mr. Chairman, one of the highlights of our FY 1985 Budget Request is our proposal to begin construction of the Very Long Baseline Array. We are requesting $15.0 million for this purpose.

THIS RADIO TELESCOPE IS THE TOP PRIORITY INSTRUMENT FOR GROUND-BASED ASTRONOMY RECOMMENDED BY THE NATIONAL ACADEMY OF SCIENCES/NATIONAL RESEARCH COUNCIL ASTRONOMICAL SURVEY COMMITTEE IN JANUARY, 1982. EARLIER TECHNICAL STUDIES OUTLINED THE SCIENTIFIC NEED AND CONCEPTUAL DESIGN FOR SUCH AN INSTRUMENT. AS YOU KNOW, OUR FY 1984 BUDGET INCLUDES $2.5 MILLION FOR ANTENNA AND INSTRUMENT DESIGN AND SITE SELECTION STUDIES WHICH ARE BEING DONE BY THE NATIONAL RADIO ASTRONOMY OBSERVATORY (NRAO). THESE DESIGN AND SITE STUDIES WILL PROVIDE THE BASIS FOR THE CONSTRUCTION TO BEGIN IN A TIMELY FASHION IN FY 1985.

OUR PROJECT DEVELOPMENT PLAN WAS SUBMITTED TO THE NATIONAL SCIENCE BOARD IN FEBRUARY, 1983, AND WITH THEIR ENDORSEMENT IT PROVIDES THE BASIS FOR OUR FY 1985 REQUEST. THE TOTAL CONSTRUCTION COSTS, IN FY 1985 DOLLARS, ARE ESTIMATED AT $64.0 MILLION. OPERATION OF PART OF THE ARRAY COULD BEGIN AS EARLY AS FY 1987 AT AN OPERATING COST OF ABOUT $2.0 MILLION PER YEAR WITH FULL ARRAY OPERATION POSSIBLE BY FY 1988 AT ABOUT $5.0 MILLION PER YEAR.

WHEN FULLY OPERATIONAL, THE VLBA WILL HAVE UP TO 1000 TIMES THE RESOLUTION OF THE BEST CONVENTIONAL TELESCOPES. THE VERY LARGE ARRAY (VLA) WHICH THE FOUNDATION PRESENTLY SUPPORTS IS HIGHLY EFFICIENT FOR LARGE SCALE ASTRONOMICAL PHENOMENA SUCH AS GALAXIES, MOLECULAR CLOUDS, AND EXTRAGALACTIC HYDROGEN. THE PLANNED VLBA WILL SIGNIFICANTLY COMPLEMENT THIS CAPABILITY AND SUBSTANTIALLY ENHANCE THE QUALITY OF ASTRONOMY WHICH U.S. SCIENTISTS CAN DO. THIS IS POSSIBLE BECAUSE THE QUALITY OF AN OBSERVATION DEPENDS ON THE DISTANCE BETWEEN OBSERVATION POINTS: THE WIDER THE SPACING THE SHARPER THE IMAGE. THE TEN RECEIVERS WHICH WILL CONSTITUTE THE NETWORK WILL EXTEND FROM HAWAII TO PUERTO RICO AND FROM NEW MEXICO TO MASSACHUSETTS. SCIENTISTS WILL USE THIS ARRAY TO MAKE COORDINATED MEASUREMENTS THAT GREATLY ADVANCE OUR BASIC UNDERSTANDING OF MAJOR ASTRONOMICAL EVENTS.

FOR EXAMPLE, THE SOURCE OF ENERGY IN QUASARS AND GALACTIC NUCLEI AND THE MANNER IN WHICH THE ENERGY IS TRANSPORTED TO DISTANT OBJECTS IS THE MOST FUNDAMENTAL PROBLEM IN EXTRAGALACTIC ASTRONOMY TODAY. THE GALACTIC JETS THAT TRANSPORT ENERGY CAN HAVE A POWER TEN BILLION TIMES THE OUTPUT OF THE SUN AND A LENGTH OF 600,000 LIGHT YEARS.

OUR EXISTING RADIO ASTRONOMY FACILITIES HAVE PRODUCED IMAGES OF THESE JETS THAT ARE FULLY EQUAL TO THOSE PRODUCED BY THE BEST OPTICAL TELESCOPES. HOWEVER, OBSERVATIONS BY THE PROPOSED VLBA WILL PROVIDE THE ONLY MEANS FOR OBTAINING HIGH RESOLUTION IMAGES OF THE CENTRAL "ENGINE" IN QUASARS AND GALACTIC NUCLEI WHICH PRODUCE THESE AWESOME JETS. OF PARTICULAR INTEREST IS THE APPARENT FASTER-THAN-LIGHT MOTION OBSERVED IN QUASARS AND RADIO GALAXIES WHICH CHALLENGE OUR MOST FUNDAMENTAL CONCEPTS OF PHYSICS AND COSMOLOGY. ONLY AN INSTRUMENT WITH THE CAPABILITIES OF THE PROPOSED VLBA WILL PERMIT THE FREQUENT AND DETAILED MULTI-WAVELENGTH OBSERVATIONS NECESSARY TO FOLLOW THE COMPLEX STRUCTURAL CHANGES WHICH OCCUR IN THESE RADIO SOURCES.

FINALLY, MR. CHAIRMAN, LARGELY AS A BYPRODUCT OF CALIBRATION PROCEDURES, THE VLBA WILL ALSO PROVE USEFUL IN PROVIDING INFORMATION ON DOWN-TO- EARTH QUESTIONS INCLUDING THE "WHY" AND "HOW" OF EARTHQUAKES. FOR EARTH STUDIES THE CRUCIAL THING TO KNOW IS THE PRECISE DISTANCE BETWEEN OBSERVATION POINTS. THEN SCIENTISTS CAN TAKE PERIODIC MEASUREMENTS AND NOTE CHANGES. THE OBSERVED DIFFERENCES REVEAL SUCH THINGS AS CONTINENTAL DRIFT. THE VLBA, WHEN TRAINED ON DISTANT QUASARS, CAN DETECT CHANGES OF A FEW CENTIMETERS IN THE RELATIVE LOCATION OF ANTENNAE SEPARATED BY SEVERAL THOUSAND OF MILES.

OUR PRESENT KNOWLEDGE OF CHANGES IN THE EARTH'S CRUST IS BASED ON PALEOMAGNETIC DATA AND OTHER INFORMATION AND IS AVERAGED OVER SEVERAL MILLION YEARS OF GEOLOGIC TIME. WITH THE VLBA, MOVEMENTS OF THE EARTH'S CRUST CAN BE MEASURED WITH HIGH PRECISION. ITS CAPABILITIES WILL ALSO PERMIT ACCURATE STUDIES OF POLAR "WOBBLE", THE MOVEMENTS OF THE EARTH'S AXIS THAT CAN OFFER EARTH SCIENTISTS CLUES TO THE DISTRIBUTION OF MASS AND THE COMPOSITION AND STRUCTURE OF THE EARTH'S INTERIOR.

I STRONGLY RECOMMEND YOUR SUPPORT OF THIS EXCEPTIONAL INSTRUMENT. IT WILL ENSURE THAT THE UNITED STATES REMAINS AT THE VERY FOREFRONT OF RESEARCH IN THESE VASTLY EXCITING AND CHALLENGING AREAS OF SCIENCE.

ADVANCED SCIENTIFIC COMPUTING

LET ME NOW TURN TO A DIFFERENT BUT EQUALLY CHALLENGING AREA OF SCIENCE: ADVANCED SCIENTIFIC COMPUTING.

MR. CHAIRMAN, COMPUTERS HAVE BEEN USED AS IMPORTANT SCIENTIFIC TOOLS FOR ALMOST 30 YEARS, BUT THEY ARE APPROACHING SUCH SOPHISTICATION AND SPEED THAT WE ARE AT THE THRESHOLD OF MAJOR NEW BREAKTHROUGHS IN OUR ABILITY TO ANALYZE AND MODEL -- AND THUS UNDERSTAND -- COMPLEX NATURAL AND MAN-MADE PHENOMENA.

SCIENTISTS AND ENGINEERS IN SOME DISCIPLINES -- ATMOSPHERIC SCIENCES AND PLASMA PHYSICS, FOR EXAMPLE -- EXTENSIVELY USE THE COMPUTATIONAL AND MODELING CAPABILITIES OF THIS NEW GENERATION OF SUPERCOMPUTERS. HOWEVER, SUPERCOMPUTERS CAN POTENTIALLY AFFECT EVERY DISCIPLINE OF SCIENCE AND ENGINEERING AND EVERY UNIVERSITY ENGAGED IN SCIENTIFIC RESEARCH.

INDUSTRY TOO IS FAST BECOMING DEPENDENT ON LARGE-SCALE, HIGH-SPEED COMPUTATION TO SIMULATE SUCH THINGS AS AIR FLOW AROUND AIRCRAFT PARTS, DEVELOP NEW DRUGS, OR CONSTRUCT THREE-DIMENSIONAL MODELS OF UNDERGROUND OIL AND WATER MOVEMENTS TO EXPLOIT OIL FIELDS. THERE IS NO DOUBT IN MY MIND THAT INDUSTRY'S ABILITY TO

SOLVE ITS PROBLEMS WILL DEPEND VERY MUCH ON UPGRADING THE TRAINING AND COMPUTATIONAL CAPABILITIES OF OUR UNIVERSITIES AND COLLEGES AND EXPANDING SUPPORT OF BASIC ENGINEERING AND SCIENTIFIC RESEARCH ON COMPUTERS AND INFORMATION PROCESSING.

LAST MAY, PARTICIPANTS IN AN NSF WORKSHOP REPRESENTING A WIDE SPECTRUM OF DISCIPLINES FROM ACADEMIA, INDUSTRY, AND GOVERNMENT RESEARCH LABS WERE ASKED TO CONSIDER POTENTIAL REQUIREMENTS IN FOUR AREAS:

O LARGE-SCALE CAPACITY;

O NEW COMPUTING CAPABILITY;

O LOCAL FACILITIES; AND

O NETWORKS

THERE WAS VIRTUALLY UNANIMOUS AGREEMENT THAT IMPORTANT SCIENCE IS NOT BEING DONE BECAUSE ACADEMIC SCIENTISTS AND ENGINEERS HAVE LIMITED ACCESS TO COMPUTATIONAL RESOURCES. WORKSHOP PARTICIPANTS ALSO RECOGNIZED A KIND OF "CHICKEN AND EGG" PROBLEM: THE NEEDS FOR ACCESS TO SUPERCOMPUTERS IN A VARIETY OF DISCIPLINES ARE NOT WELL SPECIFIED OR UNDERSTOOD, YET IT IS LIKELY THAT THEY WILL NEVER BE IDENTIFIED FULLY UNTIL SCIENTISTS HAVE MUCH BETTER ACCESS THAN AT PRESENT.

IN MANY CASES THE ACADEMIC SCIENTIFIC AND ENGINEERING COMMUNITY WILL BE LEARNING AND EXPLORING DURING THE EARLY STAGES OF ANY SUPERCOMPUTER PROGRAM, INVENTING NEW IDEAS AND REDEFINING OLD ONES AS THEY INTERACT WITH EACH OTHER AND AS THEY USE AND DEVELOP SUPERCOMPUTER SOFTWARE AND HARDWARE. AS THIS LEARNING AND EXPLORING PROCEEDS, THERE IS LITTLE DOUBT THAT THE NEED FOR LARGE-SCALE COMPUTING CAPACITY IN UNIVERSITIES WILL GROW

SUBSTANTIALLY. GIVEN THE RATE AT WHICH SUCH TECHNOLOGY IMPROVES AND CHANGES, OPENING UP STILL NEW OPPORTUNITIES FOR EXPLORATION, WE MAY NEVER CATCH UP. IN FACT, IF WE ARE DOING THINGS RIGHT, WE SHOULD NEVER CATCH UP WITH THE NEED!

WORKSHOP PARTICIPANTS ALSO AGREED THAT LOCAL FACILITIES MUST BE SIGNIFICANTLY ENHANCED FOR A BALANCED RESPONSE TO THESE NEW COMPUTATIONAL OPPORTUNITIES. SUPERCOMPUTER ACCESS SHOULD BE MANAGED AS A SCARCE RESOURCE, AND ANY CALCULATION NOT REQUIRING THIS ADVANCED CAPABILITY SHOULD BE PERFORMED ON SMALLER COMPUTERS. IN FACT, MOST SCIENTIFIC CALCULATIONS WILL NOT REQUIRE SUPERCOMPUTERS.

FINALLY, WORKSHOP PARTICIPANTS AGREED THAT SUBSTANTIALLY ENHANCED SCIENTIFIC NETWORKS LINKING MANY DIVERSE RESEARCH COMMUNITIES TO EACH OTHER AND TO COMPUTATIONAL FACILITIES ARE EXTREMELY IMPORTANT. FOR ONE THING, AN EFFECTIVE COMMUNICATIONS NETWORK WILL ENCOURAGE THE BROAD SHARING OF IDEAS AND EXPERIENCES AMONG RESEARCHERS AND HELP OVERCOME SOME OF THE FRAGMENTATION WHICH PRESENTLY EXISTS. ITS DEVELOPMENT, IN CONJUNCTION WITH THE GROWTH OF SUPERCOMPUTER CAPABILITY, WILL PUSH THE STATE-OF-THE-ART IN SOFTWARE, NETWORK DESIGN, EQUIPMENT, AND NETWORK MANAGEMENT AND GIVE RISE TO NEW, UNEXPECTED DISCOVERIES. THESE DISCOVERIES WILL BE USED TO DESIGN FUTURE COMPUTATIONAL SYSTEMS WELL BEYOND OUR CAPABILITIES TODAY. COMPUTER NETWORKS, PROPERLY DESIGNED AND MANAGED, WILL BRING ABOUT EFFICIENT, REMOTE ACCESS TO THESE SCARCE COMPUTATIONAL RESOURCES. THESE THREE THINGS WILL SUBSTANTIALLY ENHANCE THE FOUNDATION'S INVESTMENT.

THE RECOMMENDATIONS OF THIS WORKSHOP WERE REVIEWED BY THE NATIONAL SCIENCE BOARD, AS DR. GOOD'S REMARKS INDICATED, AND HAVE PROVIDED THE GENERAL FRAMEWORK FOR OUR PROGRAM IN FY 1984 AND THE FY 1985 REQUEST. WE HAVE ALSO CONDUCTED OUR REVIEW WITHIN THE CONTEXT OF A BROADER, GOVERNMENT-WIDE ASSESSMENT OF OUR NATIONAL NEEDS FOR SUPERCOMPUTERS.

An Advisory Committee for Advanced Scientific Computing has recently been established to provide additional advice and guidance to the program as it evolves. Composed of fifteen distinguished scientists and engineers representing a broad range of experiences, disciplines, and computing expertise, this Committee met for the first time in January to review our plans and progress and evaluate our proposed program directions.

In FY 1984, our first order of business is to arrange for large blocks of time at existing computational sites for NSF grantees whose research will benefit from such access. Up to $6.0 million has been set aside for this purpose so that computer service can be made available to scientists and engineers in all the disciplines represented in the NSF.

In the fall of 1983, the Foundation issued a solicitation inviting proposals which offered blocks of time for use by NSF researchers. Seven were received and have been reviewed by the NSF staff and the new Advisory Committee at its first meeting. We expect to make a decision sometime later this Spring. The plan is to arrange for up to the equivalent of one supercomputer for use by researchers.

We are requesting $20.0 million for the total program in FY 1985. While our plans are still evolving, we anticipate using up to half of this amount for supercomputer access by reseachers.

We plan to initiate an additional phase of our long-range program by the end of FY 1984 with the selection of a scientific and technical organization to manage the design, development, and eventual implementation of a new Computational Network. This Network will efficiently link researchers with each other and with existing and new supercomputer centers and their trained staffs. Until this Network is complete, or at least fairly far

ALONG, REMOTE ACCESS WILL BE LIMITED TO RELATIVELY SLOW TELEPHONE LINES, AND MANY INVESTIGATORS WILL HAVE TO BE ON SITE IN ORDER TO CONDUCT THEIR RESEARCH. SUPPORT FOR THE INITIAL STAGES OF THIS NETWORK, ABOUT $5.0 MILLION, WILL BE PROVIDED FROM OUR FY 1985 REQUEST.

ABOUT $5.0 MILLION WILL BE USED TO PROVIDE LOCAL EQUIPMENT NEEDED TO ACCESS THE COMPUTATIONAL NETWORK AND TO SUPPORT EXPERIMENTS WITH BROAD-BAND COMMUNICATIONS.

DEPENDING ON THE FINAL COST OF THE BLOCKS OF TIME WHICH WE PURCHASE IN FY 1984 AND FY 1985, IT IS POSSIBLE THAT WE MAY HAVE SUFFICIENT RESOURCES WITHIN OUR REQUEST TO CONSIDER THE INITIAL PHASE OF SUPPORT FOR A NEW SUPERCOMPUTER USER FACILITY EITHER BY ADDING ON TO AN EXISTING FACILITY OR BEGINNING A NEW CENTER. I SHALL KEEP THIS COMMITTEE FULLY INFORMED AS OUR PLANS IN THIS REGARD DEVELOP.

CROSS-DISCIPLINARY RESEARCH CENTERS IN ENGINEERING

MR. CHAIRMAN, THERE IS A THIRD EXCITING AND NATIONALLY IMPORTANT AREA IN OUR REQUEST WHICH I WOULD NOW LIKE TO ADDRESS: RESEARCH AND EDUCATION IN ENGINEERING AND OUR PLANS FOR A NEW PROGRAM OF SUPPORT FOR CROSS-DISCIPLINARY ENGINEERING RESEARCH CENTERS IN FY 1985. WE ARE PROPOSING $10.0 MILLION FOR THIS PURPOSE AND EXPECT TO FUND UP TO FIVE CENTERS IN THE FIRST YEAR. WE HAVE BEEN, AND ARE, WORKING CLOSELY WITH THE NATIONAL ACADEMY OF ENGINEERING ON THE DESIGN OF THIS PROGRAM. WHAT I WANT TO DO IN THE NEXT FEW MINUTES IS TO SAY SOMETHING ABOUT THE STATE OF ENGINEERING EDUCATION AND RESEARCH IN OUR COUNTRY TODAY AND TO SHOW HOW THIS NEW PROGRAM IS RESPONSIVE TO SOME CRITICAL CHALLENGES WHICH WE HAVE IDENTIFIED DURING THE PAST YEAR.

THERE HAS BEEN AN OUTPOURING OF CONCERN ABOUT THE STATE OF OUR ENGINEERING EDUCATION SYSTEM IN RECENT YEARS. MUCH OF THIS CONCERN HAS FOCUSED ON SHEER NUMBERS: ARE THERE SUFFICIENT HIGH-QUALITY FACULTY AVAILABLE TO TRAIN THE NUMBER OF ENGINEERS REQUIRED TO SATISFY INDUSTRY'S MANPOWER NEEDS? THERE IS EVIDENCE THAT COLLEGES AND UNIVERSITIES, INDUSTRY, GOVERNMENT, AND PROFESSIONAL SOCIETIES HAVE BEGUN TO RESPOND SUCCESSFULLY TO THESE CONCERNS BY DOING SUCH THINGS AS RAISING FACULTY SALARIES, IMPROVING THE RESEARCH ENVIRONMENT, INCREASING GRADUATE STUDENT STIPENDS, AND EXPANDING OPPORTUNITIES FOR INTERACTIONS WITH INDUSTRY. HALF OF THE FOUNDATION'S PRESIDENTIAL YOUNG INVESTIGATOR AWARDS WILL GO TO PROMISING YOUNG ENGINEERS AS AN ENCOURAGEMENT FOR THEM TO PURSUE ACADEMIC CAREERS IN TEACHING AND RESEARCH.

UNTIL RECENTLY, HOWEVER, WE HAVE NOT PAID AS MUCH ATTENTION AS WE SHOULD TO THE SUBSTANCE OF WHAT IS BEING TAUGHT IN OUR SCHOOLS OF ENGINEERING. ARE THEY PRODUCING THE KIND OF EDUCATION AND RESEARCH NEEDED BY INDUSTRY OF THE FUTURE?

LAST SUMMER, AS DR. GOOD'S REMARKS INDICATED, THE NATIONAL SCIENCE BOARD EXPLICITLY ADDRESSED THIS QUESTION AND CONCLUDED THAT NEW DIRECTIONS WERE NEEDED. THIS QUESTION HAS ALSO ENGAGED THE ATTENTION OF THE NATIONAL ACADEMY OF ENGINEERING, THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY, AND THE FOUNDATION'S OWN STAFF AND ADVISORY COMMITTEES OVER THE PAST YEAR. THERE IS AN EMERGING CONSENSUS ON THE ANSWERS, MR. CHAIRMAN.

THE ENVIRONMENT AND PRACTICE OF ENGINEERING IN INDUSTRY AND IN THE PUBLIC SECTOR HAS BEEN CHANGING DRAMATICALLY IN THE LAST DECADE AND IT IS PRETTY CLEAR THAT OUR EDUCATIONAL SYSTEM HAS NOT ALWAYS KEPT PACE. ENGINEERING PRACTICE HAS ALWAYS BEEN "CROSS-DISCIPLINARY". NOT ONLY MUST SPECIALISTS IN ONE DISCIPLINE --- ELECTRICAL ENGINEERING, FOR EXAMPLE, --- INTERACT WITH AND

UNDERSTAND THOSE IN ANOTHER --- MECHANICS --- BUT TO BE EFFECTIVE, THEY ALSO HAVE TO RELATE TO MANAGERS, POLICY MAKERS, AND OTHER SPECIALISTS FAR OUTSIDE OF ENGINEERING. THE NEED FOR SUCH "CROSS-DISCIPLINARY" INTERACTIONS HAS ACCELERATED IN RECENT YEARS IN MANUFACTURING, CONSTRUCTION, MATERIALS DESIGN AND PROCESSING, AND OTHER AREAS AS DEMANDS HAVE INCREASED FOR BETTER QUALITY, MORE PRODUCT RELIABILITY, IMPROVED COST CONTROLS, GREATER SAFETY, AND LESS ENVIRONMENTALLY INVASIVE PRODUCTS AND SERVICES.

IN SOME CASES, THE TECHNOLOGIES UNDERLYING CRITICAL INDUSTRIAL PROCESSES ARE ALSO CHANGING RAPIDLY, CREATING THE NEED FOR NEW SKILLS AND IMPROVED COMMUNICATIONS AMONG SPECIALISTS. FOR EXAMPLE, THE GROWING USE OF COMPUTERS IN INDUSTRY AND THEIR INCREASING POWER IS FUNDAMENTALLY ALTERING THE PROCESS OF DESIGN, MATERIALS HANDLING, MANUFACTURING, TESTING, AND MARKETING. WHILE UP-TO-DATE TRAINING FOR SPECIALISTS IN THESE AND OTHER AREAS IS STILL NEEDED, THERE IS A GROWING REQUIREMENT FOR ENGINEERS WITH A BROAD UNDERSTANDING OF THE "MANUFACTURING SYSTEM" AND AN ABILITY TO INTEGRATE THE MANY PARTS INTO AN EFFECTIVE WHOLE.

SOME AREAS OF INDUSTRIAL TECHNOLOGY ARE DEVELOPING VERY RAPIDLY, AND UNIVERSITIES NEED THE RESOURCES AND CAPABILITY TO IDENTIFY THEM AND TO RESPOND WITH THE KIND OF FUNDAMENTAL ENGINEERING RESEARCH THEY CAN BEST CONDUCT. NEW ELECTRONIC AND BIOLOGICAL MATERIALS, NEW COMMUNICATIONS AND INFORMATION PROCESSING TECHNIQUES AND DEVICES ARE EXAMPLES THAT COME READILY TO MIND. IN OTHER CASES INDUSTRIAL APPLICATIONS APPEAR TO HAVE ALREADY OUTSTRIPPED THE AVAILABLE BASIC KNOWLEDGE. THUS A RECENT STUDY BY THE COMMITTEE ON SCIENCE, ENGINEERING AND PUBLIC POLICY (COSEPUP) IDENTIFIED A SERIOUS NEED FOR EXPANDED RESEARCH IN FIVE AREAS OF GENERIC IMPORTANCE TO THE USE OF COMPUTERS IN DESIGN AND MANUFACTURING --- GEOMETRIC AND ANALYTIC MODELING; HUMAN - COMPUTER INTERFACES; EXPERT SYSTEMS; INFORMATION AND DATA BASE

MANAGEMENT; AND "INTELLIGENT" COMPONENTS AND DEVICES SUCH AS ROBOTIC SENSORS.

IN MOST OF THESE CASES, THE MOST EFFECTIVE RESEARCH MUST BE CROSS-DISCIPLINARY AND LONG-TERM. IT WILL ALSO GENERALLY BE INSTRUMENT INTENSIVE. FURTHERMORE, LINKS WITH INDUSTRY ARE VITAL IF ACADEMIC ENGINEERS ARE TO STAY ABREAST OF INDUSTRIAL DEVELOPMENTS.

UNFORTUNATELY, TOO MUCH OF THE EDUCATION AND RESEARCH IN OUR SCHOOLS OF ENGINEERING ARE MISSING SOME OF THESE DESIRABLE QUALITIES. RESEARCH, FOR EXAMPLE, HAS TENDED TO BE SMALL-SCALE IN NATURE WHERE SPECIFIC, WELL-FORMULATED PROBLEMS CAN BE STUDIED IN A FORMAL MANNER. FOR A VARIETY OF REASONS, SUCH AS INADEQUATE FUNDING FOR RESEARCH EQUIPMENT, INCLUDING MODERN COMPUTERS, AND A STRONGLY DISCIPLINE-ORIENTED EDUCATIONAL SYSTEM, OUR SCHOOLS HAVE FOUND IT DIFFICULT TO TRAIN THE KIND OF PEOPLE REQUIRED TO GRAPPLE WITH THE LARGER PROBLEMS OF MANAGEMENT AND SYSTEMS INTEGRATION. THERE HAS ALSO BEEN AN OVEREMPHASIS ON ANALYTICAL RESEARCH, WITH LESS OPPORTUNITY FOR "HANDS ON" EXPERIMENTAL RESEARCH; INADEQUATE EXPOSURE OF ENGINEERING STUDENTS TO ENGINEERING PRACTICE; A WIDENING GAP BETWEEN ACADEMIC ENGINEERING PROGRAMS AND INDUSTRIAL PRACTICE, AND A LACK OF INTERACTION BETWEEN FACULTY AND INDUSTRIAL PRACTITIONERS OF SYSTEMS ENGINEERING.

THE PROPOSAL TO INITIATE SUPPORT OF CROSS-DISCIPLINE ENGINEERING RESEARCH CENTERS IN FY 1985 IS A PARTIAL RESPONSE TO THIS SITUATION. IT HAS BEEN SHAPED BY THE FOUNDATION'S GENERAL RESPONSIBILITIES FOR THE HEALTH OF BASIC SCIENCE AND ENGINEERING IN THE UNITED STATES AS WELL AS BY MORE SPECIFIC GUIDANCE FROM THE NATIONAL SCIENCE BOARD AND THE NATIONAL ACADEMY OF ENGINEERING TO SEEK WAYS TO STRENGTHEN THE ENGINEERING EDUCATION AND RESEARCH CAPABILITIES OF OUR UNIVERSITIES AND COLLEGES.

WHILE THE SPECIFIC DETAILS OF THIS NEW PROGRAM ARE STILL BEING WORKED OUT, THERE IS A CONSENSUS THAT THE CENTERS WILL:

o FOCUS ON MAJOR TECHNOLOGICAL CONCERNS OF BOTH INDUSTRIAL AND NATIONAL IMPORTANCE IN ORDER TO DEVELOP FUNDAMENTAL KNOWLEDGE IN AREAS CRITICAL TO U.S. COMPETITIVENESS IN WORLD MARKETS.

o BRING TOGETHER ENGINEERS AND SCIENTISTS WITH DIFFERENT SKILLS AND BACKGROUNDS TO FACILITATE THE KIND OF "CROSS-DISCIPLINARY" INTERACTIONS AND RESEARCH WHICH PARALLELS THE WORKING WORLD OF INDUSTRY AND WHICH ARE NEEDED TO SOLVE THE LONG-TERM TECHNICAL CHALLENGES UNDERLYING EMERGING AREAS OF TECHNOLOGY.

o PROVIDE THE EXPENSIVE, STABLE EXPERIMENTAL CAPABILITIES, INCLUDING INSTRUMENTATION, SKILLED TECHNICIANS, AND MANAGEMENT NOT AVAILABLE TO INDIVIDUAL INVESTIGATORS WORKING ON SMALLER STAND-ALONE PROJECTS.

o INCLUDE PARTICIPATION BY INDUSTRIAL SCIENTISTS AND ENGINEERS TO MAKE CERTAIN THAT ACTIVITIES FOCUS ON LONG-TERM INDUSTRIAL NEEDS AND TO PROVIDE AN INDUSTRIAL "WINDOW" FOR FACULTY AND STUDENTS TO IMPROVE THEIR UNDERSTANDING OF THE PRACTICE OF ENGINEERING.

o INVOLVE BOTH GRADUATE AND UNDERGRADUATE ENGINEERING STUDENTS IN RESEARCH ACTIVITIES, GIVING THEM HANDS-ON EXPERIENCE WITH RESEARCH AND TRAINING THEM TO OPERATE MORE EFFECTIVELY IN THE "CROSS-DISCIPLINARY" WORLD OF ENGINEERING PRACTICE.

MR. CHAIRMAN, WE ARE VERY EXCITED BY THE PROSPECTS WHICH THESE CENTERS HOLD FOR CONTRIBUTING SIGNIFICANTLY TO THE SUBSTANCE AND QUALITY OF ENGINEERING RESEARCH AND EDUCATION.

In addition to our new Centers program we are requesting $137 million in FY 1985 for our other engineering activities. This will permit us to continue support for engineering research, principally through investigator-initiated project grants in such economically and scientifically significant areas as microstructure fabrications, automated design, biotechnology, tribology, and robotics.

PRE-COLLEGE SCIENCE EDUCATION

Let me now turn to the final topic which I wish to address in my remarks this morning, Mr. Chairman: pre-college science education.

As you know, the National Science Foundation Act of 1950 authorized the NSF to initiate and support programs which strengthened science education at all levels. There has been an explicit theme running through my remarks up to this point: virtually every dollar which the Foundation spends has an impact on the quality of science and engineering education available to students in our colleges and universities today in this country. Indeed, I cannot discuss any part of our research activities without also discussing education and the training of our future scientists and engineers.

However, education is a seamless web, Mr. Chairman. It begins many years before our young people are ready to enter our colleges and universities. Indeed we are learning that it begins in the home, even before children enter kindergarten.

In these early years the basic grounding in mathematical skills is laid. Students are also presented with opportunities to learn both the substance of scientific knowledge and the

NATURE OF SCIENTIFIC INQUIRY AND REASONING. OUR YOUNG PEOPLE ARE MAKING MANY CRITICAL DECISIONS ABOUT THEMSELVES, DECISIONS ABOUT THE THINGS THEY WANT TO DO, THE THINGS THEY WANT TO LEARN OR TO AVOID LEARNING, DECISIONS THAT EXPAND OR CONSTRAIN THEIR FUTURE CHOICES. MANY WILL NEVER HAVE ANOTHER OPPORTUNITY TO LEARN THE EXCITEMENT OF MATHEMATICS, SCIENCE AND TECHNOLOGY. THOSE WHO DO GO ON TO OUR COLLEGES AND UNIVERSITIES MAY OR MAY NOT BECOME OUR FUTURE SCIENTISTS AND ENGINEERS. HOWEVER, THEIR ABILITY AND FREEDOM TO MAKE THIS CHOICE IS OFTEN DETERMINED BY WHAT THEY HAVE LEARNED, OR AVOIDED, DURING THEIR CRITICAL PRE-COLLEGE YEARS.

AS YOU ARE WELL AWARE, MR. CHAIRMAN, THERE HAS BEEN A NATIONAL GROUND-SWELL OF CONCERN IN THE LAST FEW YEARS ABOUT THE QUALITY OF PRE-COLLEGE SCIENCE AND MATHEMATICS EDUCATION IN OUR NATION'S PRIMARY AND SECONDARY SCHOOLS. EDITORIALS ACROSS THE COUNTRY HAVE DECRIED THE STATE OF AFFAIRS, ATTRIBUTING IT TO A VARIETY OF CAUSES. SCHOOL BOARDS, TEACHERS ASSOCIATIONS, PARENTS GROUPS, SCIENTIFIC AND PROFESSIONAL SOCIETIES AND OTHERS IN STATE AFTER STATE ARE DISCUSSING THE PROBLEM AND PROPOSING REMEDIES.

WE HAVE BEEN WORKING VERY CLOSELY WITH THIS COMMITTEE SINCE LAST SPRING IN ORDER TO IMPLEMENT A NEW PROGRAM IN PRE-COLLEGE SCIENCE AND MATHEMATICS EDUCATION WHICH IS FULLY RESPONSIVE TO THESE CHALLENGES. IN THIS, WE HAVE BEEN GUIDED BY THE RECOMMENDATIONS OF THE NATIONAL SCIENCE BOARD COMMISSION ON PRECOLLEGE EDUCATION IN MATHEMATICS, SCIENCE AND TECHNOLOGY. THEIR REPORT IDENTIFIED THREE KINDS OF TALENT REQUIRED AMONG OUR CITIZENS:

- PROFESSIONAL SCIENTISTS, ENGINEERS, AND TECHNICIANS ---THE CENTERPIECE OF OUR TECHNOLOGICAL SOCIETY.

- THE INVESTORS, BUSINESSMEN, LEGISLATORS, AND DECISION MAKERS WHO MUST HAVE AN UNDERSTANDING OF SCIENCE AND TECHNOLOGY TO CARRY OUT THEIR DAY-TO-DAY WORK; AND o A SCIENTIFICALLY AWARE AND UNDERSTANDING CITIZENRY.

AND THIS EDUCATIONAL SYSTEM MUST SERVE STUDENTS WITH IMMENSELY VARIED ABILITIES AND CULTURAL BACKGROUNDS.

THE PROBLEM IS: HOW CAN THE NSF PROVIDE THE BASIS FOR A PRE-COLLEGE SYSTEM OF TRAINING THAT SERVES THIS FULL SPECTRUM WITH A HIGH QUALITY OF SCIENCE AND MATHEMATICS EDUCATION? WE TRADITIONALLY -- AND APPROPRIATELY -- HAVE BEEN CONCERNED WITH THE SUPPLY OF MATHEMATICIANS, SCIENTISTS, AND ENGINEERS. OUR GRADUATE PROGRAMS, OUR SUPPORT OF RESEARCH, OUR DEVELOPMENT OF MODEL PRE-COLLEGE CURRICULA IN THE MAJOR DISCIPLINES, AND OUR EFFORTS TO UPGRADE THE SKILLS OF SCIENCE TEACHERS HAVE ALL BEEN DIRECTED TOWARD THIS OBJECTIVE. AND THEY HAVE BEEN VERY SUCCESSFUL. OUR SCIENTISTS CONTINUE TO WIN NOBEL PRIZES, AND WE REMAIN THE CREATIVE SCIENTIFIC CENTER OF THE WORLD.

BUT NOW THE COUNTRY CHALLENGES US WITH A MUCH MORE DIFFICULT PROBLEM: THE QUALITY OF GENERAL EDUCATION FOR ALL STUDENTS. WE WELCOME THAT CHALLENGE; WE BELIEVE THAT NSF CAN PLAY A SIGNIFICANT ROLE.

AT THE SAME TIME, WE ARE KEENLY AWARE OF THE PLURALIST NATURE OF OUR SYSTEM. THERE ARE IMPORTANT AND APPROPRIATE LIMITATIONS -- BOTH FOR GOVERNMENT IN GENERAL AND THE NATIONAL SCIENCE FOUNDATION IN PARTICULAR. THE FEDERAL GOVERNMENT CANNOT AND SHOULD NOT BE THE CENTER OF EDUCATION; ITS ROLE MUST BE TO SUPPORT, ENCOURAGE, AND COMPLEMENT THE EFFORTS OF STATE AND LOCAL EDUCATORS.

THE ROLE OF THE NATIONAL SCIENCE FOUNDATION MUST BE EVEN MORE RESTRICTED. NSF'S PRINCIPAL STRENGTHS ARE ITS CLOSE TIES WITH ACADEMIC INSTITUTIONS, ITS EXPERIENCE IN SUPPORTING RESEARCH, AND ITS TRADITION OF PEER REVIEW TO ENSURE EXCELLENCE. IT IS NOT OUR PLACE TO PARTICIPATE MASSIVELY IN THE PRE-COLLEGE EDUCATIONAL

ENTERPRISE. RATHER, OUR BEST ROLE IS AS A CATALYST, ENCOURAGING AND SUPPORTING THE PARTICIPATION OF SUCH DIVERSE GROUPS AS SCIENTIFIC SOCIETIES, EDUCATIONAL PUBLISHERS, EDUCATIONAL DEVELOPERS, AND SCHOOL SYSTEMS. THE APPROPRIATE ROLE FOR NSF IS TO ENCOURAGE THESE DIVERSE AGENTS TO WORK TOGETHER TO PROVIDE EFFECTIVE AND PROVEN ALTERNATIVES -- FROM WHICH LOCAL SCHOOL SYSTEMS MAY CHOOSE.

WITH THESE IDEAS IN MIND, OUR INITIAL PROGRAM HAS TWO MAJOR ELEMENTS:

1. PROGRAMS TO INCREASE THE KNOWLEDGE AND SKILLS OF PRACTICING TEACHERS AND TO ENHANCE THE PRESTIGE OF THE PROFESSION; TO DEVELOP MATERIALS AND TEACHING AIDS TO MAKE SCIENTIFIC CONCEPTS CLEAR TO ALL STUDENTS; TO DEMONSTRATE NEW METHODS THAT CAN IMPROVE THE TEACHING ENVIRONMENT; AND TO INTEGRATE NEW TECHNOLOGY INTO TEACHING.

2. PROGRAMS TO UNDERSTAND BETTER SCIENCE EDUCATION PROBLEMS; ASSESS THE SUCCESS OF EXISTING AND NEW TOOLS AND METHODOLOGIES; AND PURSUE APPROACHES THAT OFFER PROMISE OF IMPROVEMENT IN SCIENCE EDUCATION OUTSIDE THE CLASSROOM.

A HYBRID MANAGEMENT STYLE IS REQUIRED TO CARRY OUT THE TASKS I HAVE OUTLINED. WE MUST HAVE A SYSTEM THAT IS OPEN TO ANY PROPOSAL OF MERIT, YET AT THE SAME TIME CAN FOCUS EFFORTS IN A PLANNED WAY SO THAT WE PROCEED FROM PROBLEM DEFINITIONS TO DESIGN, TO MAJOR DEVELOPMENT, AND FINALLY TO ACTIVE APPLICATION IN AN APPRECIABLE NUMBER OF CLASSROOMS. WE RECOGNIZE THAT EFFECTIVE EDUCATION REQUIRES A "SYSTEM PERSPECTIVE" TO MAKE CERTAIN THAT ALL OF THE PIECES ULTIMATELY CONTRIBUTE TO THE OBJECTIVE OF IMPROVED SCIENTIFIC AND MATHEMATICAL SKILLS AND UNDERSTANDING AMONG OUR VERY DIVERSE CITIZENRY. AT THE SAME TIME, ONE OF THE FOUNDATION'S GREATEST STRENGTHS LIES IN ITS CLOSE TIES WITH THE ACADEMIC SCIENTIFIC AND ENGINEERING

COMMUNITY. WE BELIEVE STRONGLY THAT WE MUST TAKE ADVANTAGE OF THESE TIES TO ENSURE THAT THE INDIVIDUAL PIECES ARE THE BEST THAT WE CAN OFFER OUR YOUNG PEOPLE.

WE ARE ENCOURAGING THE CONVENING OF PLANNING WORKSHOPS BY A VARIETY OF SCIENTIFIC, PROFESSIONAL, AND EDUCATIONAL ASSOCIATIONS TO HELP DEVELOP CONSENSUS ON NEEDS AND TO FOCUS BETTER THE PROPOSALS THAT ARE SUBMITTED TO US. WE WILL THEN USE AN ACTIVE PEER REVIEW PROCESS -- BROADENED TO INCLUDE ALL OF THE SCIENTIFIC, EDUCATIONAL, ECONOMIC, TECHNICAL, AND INSTITUTIONAL KNOWLEDGE REQUIRED FOR JUDGMENTS OF EDUCATIONAL EXCELLENCE AND UTILITY -- TO SELECT THE BEST OF THESE. WE ARE PRESENTLY DESIGNING AN ORGANIZATIONAL AND PLANNING STYLE APPROPRIATE TO THESE MANAGEMENT CHALLENGES, AND I EXPECT TO BE REPORTING ON OUR PROGRESS TO THIS COMMITTEE SOON.

THE SCIENCE AND ENGINEERING EDUCATION DIRECTORATE WAS RE-ESTABLISHED ON OCTOBER 1, 1983, AND WE ARE WORKING TO STAFF IT WITH EXPERTS IN THE APPROPRIATE FIELDS. AN ADVISORY COMMITTEE WILL SOON BE APPOINTED TO PROVIDE US WITH EXPERT VIEWS ON OUR PROGRAMS AS THEY EVOLVE. NEARLY ALL 1983 APPROPRIATED FUNDS HAVE BEEN OBLIGATED, MOSTLY TO TEACHING MATERIALS DEVELOPMENT AND HONORS TEACHER WORKSHOPS, AND WE ARE WORKING HARD TO EVALUATE THE PROPOSALS RECEIVED IN FY 1984.

WE ARE REQUESTING A TOTAL OF $54.7 MILLION FOR PRE-COLLEGE SCIENCE AND MATHEMATICS AGAIN IN FY 1985. MR. CHAIRMAN, I FIRMLY BELIEVE THAT AT THIS LEVEL WE WILL BE ABLE TO BUILD UP THE KIND OF HIGH QUALITY SCIENCE EDUCATION PROGRAM THAT IS MORE FOCUSED, MORE STABLE, AND MORE CONSISTENT THAN THOSE WE HAVE HAD IN THE PAST, A PROGRAM THAT DRAWS ON THE BEST THAT THE NSF HAS TO OFFER, ALLOWING IT TO PLAY ITS PROPER ROLE OF CATALYST AND SUPPORTER.

CONCLUSION

MR. CHAIRMAN, WE BELIEVE THAT THE ADMINISTRATION HAS SUBMITTED A WELL-BALANCED BUDGET REQUEST FOR FY 1985 FOR THE NSF. IT PROPOSES SIGNIFICANT INCREASES IN THOSE FIELDS OF RESEARCH ---CHEMISTRY, PHYSICS, MATERIALS, COMPUTER SCIENCE, ENGINEERING, PLANT BIOLOGY, GEOSCIENCE, MATHEMATICS --- WHICH ARE IMPORTANT TO OUR ECONOMIC COMPETITIVENESS AND NATIONAL SECURITY. I HAVE EMPHASIZED THREE OF OUR MOST EXCITING INITIATIVES THIS MORNING, AS WELL AS OUR EFFORTS TO WORK WITH THIS COMMITTEE TO DESIGN AN EFFECTIVE PROGRAM IN PRE-COLLEGE SCIENCE AND MATHEMATICS EDUCATION.

WE SUPPORT MANY SCIENTISTS AND ENGINEERS, DIRECTLY AND INDIRECTLY, ACROSS THE NATION. ALL OF OUR ACTIVITIES HAVE A STRONG EDUCATIONAL INFLUENCE ON OUR COLLEGES AND UNIVERSITIES. THE NEARLY 14 PERCENT INCREASE WE ARE REQUESTING IN FY 1985 WILL STRENGTHEN THESE FEATURES OF OUR PROGRAMS, ESPECIALLY OUR EMPHASIS ON RESEARCH INSTRUMENTATION.

THANK YOU, MR. CHAIRMAN. I WILL BE PLEASED TO ANSWER ANY QUESTIONS AT THIS TIME.

ROLE OF NATIONAL SCIENCE BOARD

Dr. **Knapp**. With me is Dr. Mary L. Good, Vice Chairman of the National Science Board and vice president and director of research at the Signal-UOP Research Center. Dr. Good will describe the role of the National Science Board in establishing our priorities and programs. When she is finished, I will describe our budget request, highlighting three initiatives we are proposing in fiscal year 1985.

Dr. Good.

Dr. **Good**. Mr. Chairman and members of the subcommittee, as Dr. Knapp has said, I am Mary L. Good, Vice Chairman of the National Science Board. I am also vice president and director of research at the Signal-UOP Research Center, which is the central research facility for the research companies.

It is a pleasure to have the opportunity to appear this morning and discuss some of the activities of the Board. Dr. Lewis Branscomb, our Chairman was here at the earlier hearings. I will take just a small amount of time to discuss a few issues because I believe during the last year the Board has become more cognizant of the necessity for looking at the policy changes which the Foundation is undergoing.

So I would like to look at three areas quite briefly. Those are the engineering mission of the National Science Foundation, the science and engineering education program, and scientific computing.

ENGINEERING MISSION OF THE NSF

One of the Board's most important accomplishments during the past year was its formulation of policy guidance on the engineering mission of the NSF over the next decade. The Board brought several years' work to a successful conclusion this past June. I believe the new directions will be strongly supported by the engineering community.

Engineering and manufacturing processes have been transformed by the introduction of computers, telecommunications, and information management into every phase of the industrial environment for engineering and manufacturing. The Board concluded that to meet the challenge to the Nation's engineering strength and, therefore, to its economy and security, the National Science Foundation should expand and alter its traditional role in support of engineering sciences at academic institutions.

The Foundation is already taking important steps to deal with the development of engineering faculty and to upgrade university research instrumentation. In addition, the Board believes that:

(1) NSF should provide increased support for the engineering sciences to expand the frontiers of knowledge and practice and because of their importance to U.S. economic health and security. This should include a number of areas where little support is now provided, such as software engineering, magnetic technology, bioengineering, and plasma engineering.

(2) NSF should promote the appropriate use of computers in engineering education and research, address problems of availability and

accessibility of software and hardware, and increase its participation in advancing computer engineering and other areas fundamental to computer design and implementation.

(3) NSF should increase its support for research, education and training, and transfer of knowledge and technology between academe and industry in a variety of areas, including engineering processes, materials processing, and manufacturing systems engineering.

(4) NSF should strengthen the base of academic engineering by encouraging faculty development and growth, providing suitable instrumentation and facilities, and improving the education of undergraduate engineering students.

These changed directions in NSF's engineering research and education programs will develop over the next few years. If successful, the Foundation can help our engineering schools produce graduates who are both more effective in research and better trained to enhance the Nation's productivity and competitiveness. We are excited at the prospect and urge you to help us pursue this opportunity.

SCIENCE AND ENGINEERING EDUCATION

In science and engineering education, the Commission on Precollege Education in Mathematics, Science, and Technology was established by the National Science Board and completed its work last September. This extraordinarily capable and hard-working group of people produced a report that will provide the framework for action for years to come. In its resolution accepting the report, the Board strongly endorsed the Commission's view that the rebuilding of American educational superiority in mathematics, science, and technology is essential to the country and must be achieved through the efforts of State and local governments and local communities, stimulated and assisted by Federal leadership that makes educational goals a national priority and provides support for new approaches to mathematics, science, and technology education.

Based on the work of the Commission and the Board's implementation policy, we have defined a role for the Foundation that represents a very small fraction of the national investment but a potentially very influential role in the quality of mathematics and science education. This year the Foundation must move rapidly to implement these new directions.

SCIENTIFIC COMPUTING

In scientific computing, the board has encouraged the Foundation to respond both to the need to enhance access by research scientists. to large-scale scientific computers and to support advanced research in new ideas for the design of high-speed computers. Dr. Peter Lax, a Board member, brought these issues before the Board and headed a group sponsored by DOD and NSF that prepared the "Report of the Panel on Large-Scale Computing in Science and Engineering."

This report presented the need for making advanced computing resources available to the research communities. The Director then organized a series of internal studies which the Board reviewed and endorsed. They have led to an initiative in this budget to upgrade the access by scientists and engineers to large-scale computing.

Mr. Chairman, during the past year the board has dealt successfully with major issues that will have a significant impact on the Nation's scientific and technological future. We have developed an important level of consensus on these issues, clearing the way for effective action. The Director, with the support of the administration, has moved expeditiously and strongly to implement these strategic directions for the National Science Foundation. We urge you and your members to support these directions.

We surely do agree with Dr. Knapp's thanks for your help and support in the past. I appreciate very much the opportunity to testify. Thank you, sir.

Senator GARN. Thank you very much.

[The statement follows:]

STATEMENT OF DR. MARY L. GOOD

Mr. Chairman and Members of the Subcommittee,

I am Mary L. Good, Vice Chairman of the National Science Board. I am also Vice President and Director of Research at UOP Inc. It is my pleasure to appear before you this morning to discuss recent activities of the Board. Dr. Lewis M. Branscomb, our Chairman, visited with you last month and discussed a number of our activities, so I will be brief. Let me focus especially on three areas: (1) the engineering mission of the NSF, (2) science and engineering education, and (3) scientific computing.

The Engineering Mission of the NSF

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Thank you for this opportunity to testify.

VERY LONG BASELINE ARRAY

Dr. KNAPP. Mr. Chairman, one of the highlights of our fiscal year 1985 budget request is our proposal to begin construction of the very long baseline array (VLBA). We are requesting $15 million for this project.

This radio telescope is the top-priority instrument for ground-based astronomy recommended by the National Academy of Sciences/National Research Council Astronomical Survey Committee in January 1982. Earlier technical studies outlined the scientific need and conceptual design for such an instrument.

When fully operational, the VLBA will have up to 1,000 times the resolution of the best conventional telescopes. Scientists will use this array to make coordinated measurements that greatly advance our basic understanding of major astronomical events.

I strongly recommend your support of this exceptional instrument. It will insure that the United States remains at the very forefront of research in these vastly exciting and challenging areas of science.

ADVANCED SCIENTIFIC COMPUTING

Let me now turn to advanced scientific computing. Computers are approaching such sophistication and speed that we are at the threshold of major new breakthroughs in our ability to analyze and model complex natural and manmade phenomena. Industry is fast becoming dependent on large-scale, high-speed computation to simulate such diverse problems as air flow around aircraft parts or oil field reservoir drawdown. Industry's ability to solve problems utilizing these computers will depend very much on upgrading the training and computational capabilities of our universities and colleges.

There is virtually unanimous agreement that important science is not being done because academic scientists and engineers have limited access to computational resources. I will be pleased to discuss our supercomputer program in more detail in future testimony before this committee.

CROSS-DISCIPLINARY ENGINEERING RESEARCH CENTERS

A third exciting and nationally important area in our request is research and education in engineering and our plans for a new program of support for cross-disciplinary engineering research centers in fiscal year 1985. We are proposing $10 million for this purpose and expect to fund up to five centers in the first year. We have been, and are, working closely with the National Academy of Engineering on the design of this program.

Engineering practice has always been cross-disciplinary, usually using a team approach to solve industrial problems. The need for such cross-disciplinary interactions is particularly acute in R&D-intensive industries. In some cases, the technologies underlying critical industrial processes are also changing rapidly, creating the need for new skills and improved communications among specialists.

The most effective engineering research must be cross-disciplinary and long term. It will also generally be instrument intensive.

The proposal to initiate support of cross-disciplinary engineering research centers in fiscal year 1985 is a partial response to this situation. While the specific details of this new program are still being worked out, these centers will focus on technological concerns of both industrial and national importance; bring together engineers and scientists with different skills and backgrounds; provide expensive, stable experimental capabilities, not available to individual investigators; include participation by industrial scientists and engineers; and involve both graduate and undergraduate engineering students in research activities.

Mr. Chairman, we are very excited by the prospects which these centers hold for contributing significantly to the substance and quality of engineering research and education.

PRECOLLEGE SCIENCE AND MATHEMATICS EDUCATION

The final topic which I wish to address is precollege science education. There has been an explicit theme running through my remarks up to this point: Virtually every dollar the Foundation spends has an impact on the quality of science and engineering education available to students in our colleges and universities today. However, education is a seamless web. It begins many years before our young people are ready to enter our colleges and universities.

There has been a national ground swell of concern about the quality of precollege science and mathematics education. We have been working very closely with this committee to implement a new program in precollege science and mathematics education. We have traditionally, and appropriately, been concerned with the supply of mathematicians, scientists, and engineers. But now the country challenges us with a more difficult problem: the quality of general education for all students.

NSF's principal strengths in tackling this problem are its close ties with academic institutions, its experience in supporting research, and its tradition of peer review. The appropriate role for NSF is to encourage diverse groups such as scientific societies, educational publishers, educational developers, and school systems to work together to develop effective and proven alternatives from which local school systems may choose.

Our initial program has two major elements. The first includes programs to increase the knowledge and skills of practicing teachers and to enhance the prestige of the profession. These programs will support the development of materials and teaching aids to make scientific concepts clear to all students, demonstrate new methods that can improve the teaching environment, and integrate new technology into teaching.

The second element includes programs to understand science education problems better, evaluate national educational progress in science and math education, and pursue approaches that offer promise of improvement in science education outside the classroom.

A hybrid management style is required to carry out the tasks I have outlined. We must have a system that is open to any proposal of merit yet, at the same time, can focus efforts in a planned way so as to achieve application in the classroom. We are presently designing an organizational and planning structure appropriate to these management challenges, and I will be reporting on our progress to this committee soon.

We are requesting a total of $54.7 million for precollege science and mathematics education in fiscal year 1985. Mr. Chairman, I firmly believe that at this level we can build the kind of high-quality science education program that is more focused, more stable, and more consistent than those we have had in the past, a program that draws on the best that NSF has to offer, allowing it to play its proper role as catalyst and supporter.

Thank you, Mr. Chairman. I will be pleased to answer any questions at this time.

Senator GARN. Thank you, Dr. Knapp.

PROPOSED CHANGES IN APPROPRIATION LANGUAGE

Last year the Congress included in your appropriations language a 1-year limitation on the availability of funds for program development and management. These are the traditional salaries and expense funds that are generally limited in our bill to a 1-year period.

Has this limitation caused the Foundation any hardship to date, and what benefits do you see for the Foundation if such a limitation was not included in fiscal year 1985?

Dr. KNAPP. This limitation has not caused any hardship as yet because it pertains to fiscal year 1984, and we have not had to close out our accounts for 1984. So the time this sort of limitation would cause hardship to the Foundation would be at the time we close out the accounts where we have no flexibility in carrying forward moneys from one year to the next.

I can't really say whether or not including a limitation in the 1985 budget would cause any hardships. I realize that most agencies do live with this kind of a limitation. It is difficult, I know, at the closeout time to make things balance. We did come within a few tenths of 1 percent last year of obligating all of the funds for that fiscal year.

Senator GARN. You are also proposing that a provision that was recommended by this subcommittee be deleted from your appropriations language in fiscal year 1985. What I am specifically referring to is the provision under science education that earmarked up to $5 million in science education funds for transfer to your research and related activities program. The Congress inserted this provision to insure that the science education directorate would be working in close conjunction with the other research directorates in defining necessary research on teaching and learning.

Has the science education directorate been involved in discussion with the other research directorates, especially the biological, behavioral, and social sciences (BBS) directorate, to define such necessary research?

Dr. KNAPP. Yes, they have been involved.

Senator GARN. Why are you recommending the deletion of this language in fiscal year 1985?

Dr. KNAPP. The recommendation for this deletion is a technical matter only, having to do with budgeting administration and responsibility. The $3 million has been located in the BBS directorate, as recommended by your committee. However, the funds have not been transferred. As I say, this is a technical matter. It is an accounting problem within the Foundation. We have not transferred the funds, but the responsibility and administration are located in the BBS directorate.

Senator GARN. How much money have you transferred to these other directorates for such research in fiscal year 1984?

Dr. KNAPP. We have transferred no other funds to other directorates in 1984.

RESEARCH GRANTS

I think we should, perhaps, include for the record the program announcement of the program within the BBS directorate which indicates the funds and the way they are being spent. As I say, the transfer of funds is a technical matter; it is not a substantive matter. We are carrying out the desires of your committee.

[The information follows:]

[Program announcement]

GRANTS FOR RESEARCH ON THE TEACHING AND LEARNING OF SCIENCE AND MATHEMATICS

Program description

The National Science Foundation intends to provide five million dollars to enhance support for research on teaching, learning, and cognition in the fiscal year beginning October 1, 1983. Support will be provided for both basic and applied research on significant factors that underlie effective teaching and learning of mathematics and science at the pre-college level. Basic research will be supported by the Directorate for Biological, Behavioral and Social Sciences (BBS), through the Divisions of Behavioral and Neural Sciences, Information Science and Technology, and Social and Economic Science. Applied research will be supported by the Directorate for Science and Engineering Education (SEE), as also announced previously in NSF 83-6, Materials Development for Pre-College Science and Mathematics.

The FY 1984 HUD-Independent Agencies Appropriations Act (PL98–45) authorizes the Director of the Foundation to make available funds from the Science and Engineering Education account for "research on teaching and learning." This research emphasis reflects Congressional concern about the current status of education in science, mathematics, and engineering, and is responsive to recent reports of public and private commissions which have expressed serious concerns about the adequacy of U.S. educational efforts in these fields.

The following topics are examples of the types of research that may be supported. The topics are illustrative only and research proposals on other topics dealing with the teaching and learning of science and mathematics at the pre-college level are encouraged.

—Research on early development of cognitive competence, including research on early language acquisition, the development of logical and mathematical competence, and the processes by which students learn to solve problems in logic, mathematics, and science.

—Research on the effects of incorporating information processing technology into the traditional school setting; patterns of diffusion and adoption of technology; and analyses of differences in student achievement using traditional methods compared with using new technologies.

—Research to advance the understanding of the nature of learning, such as research on the interactions between the students' representation of knowledge of and the processing involved in the acquisition of new knowledge.

—Research on artificial intelligence and other information-processing models as a basis for improving the teaching and learning of science.

—Research on the factors that influence school achievement inscience and mathematics at various ages, including the effects of family backgrounds, gender, peer group relationships, and school environment.

—Research on the factors that influence the differential enrollment and achievement of students in pre-college courses in mathematics and science.

Preparation and submission of proposals

Research proposals should be prepared in accordance with the instructions contained in "Grants for Scientific and Engineering Research" (NSF 83–57). The cover page of the proposal should note the NSF program to which the proposal is submitted in response to this announcement. The Foundation welcomes proposals on behalf of all qualified scientists and engineers and strongly encourages women and minorities and the handicapped to compete fully in the research programs described in this announcement.

Proposals should be submitted to the Data Support Services Section, National Science Foundation, Washington, D.C. 20550. Twenty copies of proposals are required, one of which must be signed by the Principal Investigator(s) and an official authorized to sign for the institution. Formats for the cover page, project summary, proposal summary budget, and current and pending support are contained in the appendices to "Grants for Scientific and Engineering Research."

To be considered for support in Fiscal Year 1984, proposals should be received no later than February 1, 1984. Proposals received after February 1, 1984 will be considered for support in Fiscal Year 1985, depending on the availability of funds.

Evaluation of proposals

Proposals will receive peer review using the criteria described on page 9 of NSF 83–57. Peer review may include ad hoc mail review by experts in the specific subject matter and/or evaluation by established review panels.

Applicants will be informed of the Foundation's decision within six to nine months of receipt of proposals. Normally, awards will not be made for a period to exceed 36 months.

Award administration

Grants are administered in accord with the terms and conditions of NSF F.L. 200, "Grant General Conditions," copies of which may be obtained from the NSF Forms and Publications Unit. [More comprehensive information is contained in the "NSF Grant Policy Manual" [Revised] available through the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.] This program is described in the Catalog of Federal Domestic Assistance Category 47-051.

REPROGRAMING OF FUNDS

Senator GARN. Last year we spent a considerable amount of time at the hearings on the issue of reprograming procedures. Since those hearings, you instituted a set of reprograming procedures that are working quite well, I think. I would like to thank you and Ray Bye for your efforts in solving that problem.

Dr. KNAPP. Thank you, Mr. Chairman.

STATUS OF U.S. SCIENCE

Senator GARN. Every year it is fashionable to bemoan the state of U.S. science. Although I believe that a certain amount of concern is always warranted on an issue as important to our national economy and security, we also need to keep things in perspective.

For instance, U.S. science and technology still leads the world. In physics, chemistry, and medicine, U.S. scientists have won or shared 34 of 49 Nobel Prizes during the last 11 years.

I would like to explore each of several recent trends and ask you to comment on their immediate impact and their implication for the future.

First, according to a recent NSF survey, total company-funded expenditures on research and development in the United States are estimated to reach $44 billion in 1983, an increase of 9 percent over the preliminary 1982 level. Furthermore, based on expectation of continuing economic recovery, companies' R&D investment is expected to grow approximately 11 percent during 1984 to $48 billion.

Would you comment on this trend of increased R&D expenditures in the private sector?

Dr. KNAPP. I think, Mr. Chairman, that that is an indication of the importance that R&D has in our economy and for our industry. I think it also indicates the importance of the training that we provide and the research that we do at universities, the importance which that has to our industries, and the provision of manpower for these increased R&D expenditures by industry.

I might comment on the initial part of your question. It, in a sense, has been fashionable to worry about the state of science. I think, however, that was a well-taken worry. I think that, in fact, American science, over the last few years, has been in a great deal of difficulty in universities. I think the leadership of your committee in providing the budget increases we have had over the past 3 or 4 years has been extremely important in reversing this trend and making science considerably more healthy in the universities than, say, it was 5 years ago.

Dr. GOOD. Mr. Chairman, I would like to comment on the industry one, if you don't mind.

I think that trend you see is actually one that is going to continue. I think U.S. industry has begun to understand the need for long-term research programs which have continuity, and I think that is what you are seeing.

If you note, it was interesting because R&D in the private sector was maintained even during a recent rather drastic recession. I think that is the first time that has happened in quite some time. It really indicates a change of attitude with respect to the high-technology industries in the country and their understanding that that is what is required to stay competitive with the rest of the world. It is a response to international competition.

Also, I think the Congress should be thanked a little bit. Certainly, from my own perspective in my own company, there is no question that the Tax Recovery Act that was passed in 1981 has indeed had some significant effects. I think the Congress should understand that.

QUALITY OF SCIENCE AND ENGINEERING STUDENTS

Senator GARN. I find very little to thank the Congress for lately, so I appreciate being made aware of something. [Laughter.]

A recent survey of senior academic officials at 486 undergraduate and 383 graduate institutions shows that a majority believe that there has been no significant change in the quality of science and engineering students over the past 5 years. Sixty percent reported no change in quality of S&E undergraduate or graduate students. Although the majority of those asked indicated no change, most of the rest expressed views that point toward quality improvement: 25 percent reported significant improvement among S&E undergraduates and 15 percent indicated significant decline. In addition, the survey found that officials of the 100 largest S&E undergraduate-producing institutions reported a shift of the most able undergraduate students toward S&E fields. Almost none reported a shift away from S&E fields.

Would you comment on those findings?

Dr. KNAPP. Yes. I think we can take those findings as really very positive for the National Science Foundation and science and engineering in the United States. I think that students are again realizing that careers in science and engineering are really excellent careers, things which will provide a challenge for their future and a stable employment opportunity.

I think we are seeing excellent students going into the science and engineering fields, as they did in the fifties and early sixties. We saw a general shift of people from science and engineering fields in the seventies for a variety of reasons that I really don't understand very well. But I think we are seeing good students returning to science and engineering in large numbers. I am very pleased with that. I hope that we have a university environment in which they can prosper and go forward into industry to be very productive for our country.

Dr. GOOD. Mr. Chairman, may I make just an anecdotal comment on that.

Our laboratory happens to be one of those that is in the nice position of recruiting heavily at the moment, particularly at the Ph. D. level in chemistry, engineering, and materials science. I can attest to the fact that the people we are seeing are really very good these days. They are just excellent.

I would also, though, like to point out that the group you are trying to attract, the very best, are not without offers, either. In almost every case, we are competing with at least two or three other very highly motivated R&D companies. So there are some very good people out there, but industry is recruiting them pretty heavily.

JOB MARKET FOR SCIENTISTS AND ENGINEERS

Senator GARN. To follow up on that, a recent article in Science found that a softer job market for scientists and engineers is indicated by data from more than 50 recent surveys. The Scientific Manpower Commission's biennial report, which is essentially a survey of surveys, suggests that economic conditions apparently caught up with the groups covered in the survey. The change of fortune for engineering graduates was particularly pronounced after several years in which there were rapid increases in both levels of salaries offered and the number of jobs available despite the recession.

Could you comment further, maybe Dr. Good, on the trends in the job market, maybe from a broader perspective than your own recruiting.

Dr. GOOD. There is no question that there are certain areas in engineering which have major increases in numbers of students that came into those disciplines in the late seventies and early eighties. Chemical engineering is one example. There was a very large increase in the number of students in that area. The backing away from programs like synfuels, for example, has meant that the demand for those people is now less than it was when students decided to go into those areas. So there is indeed a mismatch. The numbers are out of line, but there is always a mismatch between the students coming out and the job market. The difficulty is that you can't anticipate 4 years for engineering students and 8 to 10 years for Ph. D. students what the precise job market is going to look like when those students get out.

One of the things that is happening, though, which is a plus, is that the majority of the good students are getting offers in their fields. One of the things that has changed is that, for example, in 1980, chemical engineering students—the good ones—were looking at 6, 8, or 10 offers, as many as they were willing to take trips. Today, they may be looking at one or two, but most of them are still looking at that one or two.

The real difficulty is that it simply isn't possible to match what is going to be precisely needed that far in the future. We have never been able to do that well. I doubt seriously that we will ever be able to do it totally adequately.

There are some other areas, like materials science, for example, which are growing very fast, and at the moment the universities simply haven't caught up with that. We are seeing more students in that area. They are beginning to come out.

One of the other nice things is that the students learn how to deal with changing situations fairly quickly, because some of the bright chemical engineers are shifting. In other words, they are doing their graduate work in one of these areas which now has a stronger demand. You see that sort of shifting about.

But for the job market overall, the Deutsch, Shea, and Evans Index for science and engineering personnel went up dramatically in the last 2 or 3 months. It is certainly true the demand is getting even better than it was 6 years ago.

Senator GARN. Maybe the mismatches could run for Congress. We have all kinds of mismatched people here that didn't fit any place else so they got into politics. [Laughter.]

Dr. GOOD. We would like to see scientists in the Congress.

Senator GARN. We had one, but the voters of New Mexico decided they wanted to bring him home. [Laughter.]

In the last 2 years, the President has asked for a 17.7 percent and 13.7 percent increase in Federal R&D. Do you believe that the overall proposed funding levels are appropriate at this time, that they fit the needs that we face?

Dr. KNAPP. I think they are appropriate or, perhaps, not even enough. We have very serious international competition. To meet that competition we will need trained manpower which will be productive and take our industries in new directions.

To back up just a minute and talk about these manpower surveys, I would like to add a little bit of my own personal comment to what Dr. Good has said.

The market for jobs is very elastic. It also is very dependent upon what has been available. A company will advertise for engineers. If it feels that there aren't enough engineers in the market to satisfy its needs, it will change what it advertises for. It will change its job mix in order to be able to be successful in what it does. We see a good bit of that in the job market that we have right now. Just coming out of a recession, with certain changes in the whole industry mix in our country, we are seeing changes in what we need in industrial employment. These things always take a while to adjust.

JAPANESE ENGINEERING GRADUATES

I must just comment that the Japanese graduate twice as many engineers per capita as this country does. They absorb them all very well into their industry and in a very productive way. I believe if we had twice as many engineering graduates, in a few years industry would find that it could do much better than it is doing right now with the way it designs its products and the way it engineers them for sale, if it had a more knowledgeable work force.

So, probably, these surveys give a very precise feel of what employment can be or the need the country has for technical manpower.

Senator GARN. I understand what you are saying. It has been my experience, though, there is a different attitude in Japan in general. Our engineering graduates would not take some of the jobs those engineering graduates do. They would be put in the overqualified category for that job.

It is interesting to me, down at some of the supervisory levels, out on the assembly lines and so on, they are graduate engineers, very highly skilled and trained, where here we would not even probably have college graduates in some of the areas those engineers are willing to take and work up through the chain, I suppose. In all fields here, we have developed a more superior attitude, that if we have a college degree, that we are supposed to start, if not at the top, at least in the upper third [laughter] and are not willing to take those years to work up to the higher levels. The Japanese don't have that kind of an attitude.

Dr. GOOD. I think the job situation this year, for example, for chemical engineers, does certain things to mitigate that. First of all, they are available so the industry can hire them to do some of those types of manufacturing. These are engineers they could not get in the past. Also, in the type of job market that is there, these engineers are more likely to accept those kinds of positions and do well with them.

FISCAL YEAR 1985 FEDERAL RESEARCH DISTRIBUTION

Senator GARN. Do you believe the DOD versus non-DOD and basic research versus nonbasic research distribution proposed in the fiscal year 1985 Federal budget is appropriate?

Dr. KNAPP. Yes, I do, Senator.

NUMBER OF GRANTS

Senator GARN. Over the last year, you and I have discussed in some detail the need to target some of the increased resources requested by NSF to fund additional grants.

In response to my letter of February 3 on this subject, you made a commitment to fund at least an additional 500 grants in fiscal year 1984 above the level funded in fiscal year 1983.

In light of this commitment, could you please, for the record, update the tables in your budget justification accordingly?

Dr. KNAPP. Yes. We will provide that for the record.

[The information follows:]

Research and Development Special Analysis: National Science Foundation

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$999,135,522	$1,172,465,698	$1,335,808,534
Applied Research	62,854,206	66,013,662	78,208,466
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	1,061,989,728	1,238,479,360	1,414,017,000
(Conduct of R&D Performed by Universities and Colleges)	(768,207,859)	(888,678,766)	(1,007,664,160)
R&D Facilities:			
Land, Buildings and Fixed Equipment	3,248,500	9,100,000	12,550,000
Total, Support of R&D	1,065,238,228	1,247,579,360	1,425,567,000
Education and Training	16,086,570	83,913,430	70,700,000
Collection of Information	4,465,432	4,450,000	4,525,000
TOTAL	$1,085,790,230	$1,335,942,790	$1,501,792,000

Quantitative Data Table: National Science Foundation

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	30,736	34,670	38,385
Dollars Requested (Total)	$4,241,589,530	$5,108,395,344	$5,990,577,733
Action Summary			
Number of Awards	11,636	12,377	12,607
Dollars Obligated (Total)	1,085,790,230	1,335,942,790	1,501,792,000
Dollar Distribution of Funds by Performer			
Universities	798,693,285	980,397,429	1,105,069,160
Industry	28,517,572	37,518,290	45,633,680
Federal Agencies	70,017,649	78,673,506	90,429,320
Other	188,561,724	239,353,565	260,659,840
Research Activities			
Personnel			
Senior Scientists:			
Number of Scientists Supported	12,878	13,544	14,247
Amount of Scientist Support	128,234,520	144,605,787	161,994,391
Number of Years of Scientist Support	3,243	3,466	3,724
Postdoctoral Support:			
Number of Postdoctorals Supported	3,118	3,326	3,512
Amount Postdoctoral Support	44,216,428	51,762,528	57,828,319
Graduate Students:			
Number of Students Supported	9,839	10,627	11,628
Amount Graduate Student Support	76,556,440	89,569,804	103,480,867
Other Personnel Costs:			
Amount of Support	175,837,682	194,843,995	217,874,472
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	3,248,500	9,100,000	12,550,000
Major Equipment	16,463,357	36,400,000	44,700,000
Other Equipment and Instrumentation	100,930,396	151,501,442	179,738,448
Other Direct Research Costs:*	254,193,461	272,861,854	313,224,283
Indirect Costs:	270,022,876	296,363,950	334,701,220
SUBTOTAL	$1,069,703,660	$1,247,029,360	$1,426,092,000

Science and Engineering Education Activities

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Personnel and Other Award Factors			
Professional Staff Costs	$655,135	$28,952,490	$23,189,320
Other Staff Costs	414,450	5,679,360	4,560,970
Subtotal, Staff Costs	1,069,585	34,631,850	27,750,290
Expendable Supplies & Equipment	96,445	2,189,840	1,694,833
Permanent Equipment	—0—	3,400,000	2,700,000
Other Project Direct Costs	263,248	3,465,587	4,478,101
Subtotal, Nonstaff Project Costs	359,693	9,055,427	8,872,934
Total, Direct Costs	1,429,278	43,687,277	36,623,224
Indirect Costs	560,625	17,504,320	14,026,776
Participant Support Costs:			
Stipend & Other Personal Allowances	8,923,578	20,401,300	17,982,010
Cost-of-Education Allowances	5,173,089	7,320,533	7,067,990
Total, Participant Support Costs	14,096,667	27,721,833	25,050,000
SUBTOTAL	$16,086,570	$88,913,430	$75,700,000
TOTAL	**$1,085,790,230**	**$1,135,942,790**	**$1,501,792,000**

* Includeds: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Mathematical and Physical Sciences

Support of R&D			
Conduct of R&D:			
Basic Research	$291,220,455	$346,669,200	$402,541,000
Applied Research	10,726,835	12,153,800	14,169,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	301,947,290	358,823,000	416,710,000
(Conduct of R&D Performed by Universities and Colleges)	(282,133,837)	(335,228,670)	(388,224,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	301,947,290	358,823,000	416,710,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$301,947,290	$358,823,000	$416,710,000

Quantitative Data Table: Mathematical and Physical Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	6,338	6,507	6,720
Dollars Requested (Total)	$1,109,032,832	$1,204,000,000	$1,302,000,000
Action Summary			
Number of Awards	3,489	3,649	3,793
Dollars Obligated (Total)	301,947,290	358,823,000	416,710,000
Average Award Size	86,543	98,335	109,863
Average Award Duration (Years)	1.1	1.1	1.1
Dollar Distribution of Funds by Performer			
Universities	296,607,838	352,695,500	410,090,000
Industry	1,198,295	1,038,000	1,265,000
Federal Agencies	1,258,742	1,000,000	1,100,000
Other	2,882,415	4,089,500	4,255,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	4,516	4,660	4,786
Amount of Scientist Support	39,242,087	43,600,000	47,650,000
Number of Years of Scientist Support	878	908	947
Postdoctoral Support:			
Number of Postdoctorals Supported	1,468	1,560	1,640
Amount Postdoctoral Support	23,049,622	27,725,000	30,930,000
Graduate Students:			
Number of Students Supported	4,232	4,489	4,985
Amount Graduate Student Support	31,614,778	36,100,000	42,130,000
Other Personnel Costs:			
Amount of Support	30,706,613	34,500,000	38,100,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	13,827,623	16,500,000	19,900,000
Other Equipment and Instrumentation	45,837,746	65,660,000	79,100,000
Other Direct Research Costs: *	44,239,950	51,568,000	61,840,000
Indirect Costs:	73,428,871	83,170,000	97,060,000
TOTAL	$301,947,290	$358,823,000	$416,710,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Mathematical Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$34,408,297	$41,085,000	$49,995,000
Applied Research	347,559	415,000	505,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	34,755,856	41,500,000	50,500,000
(Conduct of R&D Performed by Universities and Colleges)	(33,018,063)	(39,425,000)	(47,975,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	34,755,856	41,500,000	50,500,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$34,755,856	$41,500,000	$50,500,000

Quantitative Data Table: Mathematical Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,936	1,950	2,000
Dollars Requested (Total)	$123,152,832	$127,000,000	$140,000,000
Action Summary			
Number of Awards	927	930	945
Dollars Obligated (Total)	34,755,856	41,500,000	50,500,000
Average Award Size	37,493	44,624	53,439
Average Award Duration (Years)	1.2	1.2	1.2
Dollar Distribution of Funds by Performer			
Universities	33,018,063	39,425,000	47,975,000
Industry	—0—	—0—	—0—
Federal Agencies	14,990	—0—	—0—
Other	1,722,803	2,075,000	2,525,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	1,250	1,250	1,275
Amount of Scientist Support	12,047,676	13,500,000	14,900,000
Number of Years of Scientist Support	250	244	259
Postdoctoral Support:			
Number of Postdoctorals Supported	104	150	200
Amount Postdoctoral Support	2,931,630	3,700,000	4,700,000
Graduate Students:			
Number of Students Supported	370	500	875
Amount Graduate Student Support	1,365,076	2,300,000	4,000,000
Other Personnel Costs:			
Amount of Support	3,137,094	4,200,000	5,100,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	1,658,802	1,730,000	2,500,000
Other Direct Research Costs:*	4,739,592	5,400,000	6,300,000
Indirect Costs:	8,875,986	10,670,000	13,000,000
TOTAL	$34,755,856	$41,500,000	$50,500,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Computer Research

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$28,340,172	$32,801,200	$38,126,000
Applied Research	999,276	1,098,800	1,224,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	29,339,448	33,900,000	39,350,000
(Conduct of R&D Performed by Universities and Colleges)	(23,562,424)	(26,303,670)	(29,619,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	29,339,448	33,900,000	39,350,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$29,339,448	$33,900,000	$39,350,000

Quantitative Data Table: Computer Research

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	600	625	625
Dollars Requested (Total)	$153,380,000	$180,000,000	$187,000,000
Action Summary			
Number of Awards	292	311	330
Dollars Obligated (Total)	29,339,448	33,900,000	39,350,000
Average Award Size	100,478	109,003	119,242
Average Award Duration (Years)	1.3	1.3	1.3
Dollar Distribution of Funds by Performer			
Universities	28,038,705	32,685,500	38,600,000
Industry	395,823	—0—	—0—
Federal Agencies	443,752	—0—	—0—
Other	461,168	1,214,500	750,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	374	384	393
Amount of Scientist Support	4,174,411	4,500,000	5,100,000
Number of Years of Scientist Support	93	95	97
Postdoctoral Support:			
Number of Postdoctorals Supported	15	15	15
Amount Postdoctoral Support	307,992	325,000	350,000
Graduate Students:			
Number of Students Supported	355	390	430
Amount Graduate Student Support	3,519,702	4,100,000	4,800,000
Other Personnel Costs:			
Amount of Support	3,809,519	4,000,000	4,400,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	4,827,623	6,500,000	8,200,000
Other Equipment and Instrumentation	1,588,944	2,000,000	2,200,000
Other Direct Research Costs:*	4,158,372	4,475,000	5,000,000
Indirect Costs:	6,952,885	8,000,000	9,300,000
TOTAL	$29,339,448	$33,900,000	$39,350,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Physics

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$85,043,570	$101,500,000	$116,870,000
Applied Research	4,100,000	4,400,000	4,900,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	89,143,570	105,900,000	121,770,000
(Conduct of R&D Performed by Universities and Colleges)	(79,543,350)	(95,200,000)	(109,270,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	89,143,570	105,900,000	121,770,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$89,143,570	$105,900,000	$121,770,000

Quantitative Data Table: Physics

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	770	857	920
Dollars Requested (Total)	$380,400,000	$402,000,000	$426,000,000
Action Summary			
Number of Awards	493	524	555
Dollars Obligated (Total)	89,143,570	105,900,000	121,770,000
Average Award Size	180,819	202,099	219,405
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	88,831,070	105,575,000	121,435,000
Industry	12,500	25,000	35,000
Federal Agencies	100,000	100,000	100,000
Other	200,000	200,000	200,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	843	874	898
Amount of Scientist Support	8,700,000	9,400,000	10,000,000
Number of Years of Scientist Support	230	240	250
Postdoctoral Support:			
Number of Postdoctorals Supported	340	355	370
Amount Postdoctoral Support	6,200,000	7,400,000	8,100,000
Graduate Students:			
Number of Students Supported	746	765	780
Amount Graduate Student Support	5,400,000	6,600,000	7,200,000
Other Personnel Costs:			
Amount of Support	11,300,000	12,000,000	12,600,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	9,000,000	10,000,000	11,700,000
Other Equipment and Instrumentation	16,300,000	22,400,000	26,300,000
Other Direct Research Costs:*	12,443,570	17,100,000	21,370,000
Indirect Costs:	19,800,000	21,000,000	24,500,000
TOTAL	$89,143,570	$105,900,000	$121,770,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Chemistry

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$66,548,444	$78,560,000	$90,250,000
Applied Research	1,080,000	1,440,000	1,840,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	67,628,444	80,000,000	92,090,000
(Conduct of R&D Performed by Universities and Colleges)	(66,610,000)	(78,900,000)	(90,860,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	67,628,444	80,000,000	92,090,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$67,628,444	$80,000,000	$92,090,000

Quantitative Data Table: Chemistry

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,704	1,700	1,750
Dollars Requested (Total)	$166,000,000	$175,000,000	$189,000,000
Action Summary			
Number of Awards	962	1,020	1,069
Dollars Obligated (Total)	67,628,444	80,000,000	92,090,000
Average Award Size	70,300	78,431	86,146
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	67,320,000	79,610,000	91,580,000
Industry	110,000	190,000	230,000
Federal Agencies	—0—	—0—	—0—
Other	198,444	200,000	280,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	868	908	951
Amount of Scientist Support	5,920,000	6,900,000	7,750,000
Number of Years of Scientist Support	125	146	155
Postdoctoral Support:			
Number of Postdoctorals Supported	579	580	580
Amount Postdoctoral Support	8,010,000	9,600,000	10,280,000
Graduate Students:			
Number of Students Supported	1,361	1,384	1,400
Amount Graduate Student Support	10,030,000	10,900,000	13,130,000
Other Personnel Costs:			
Amount of Support	5,560,000	5,600,000	6,000,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	12,490,000	20,030,000	23,400,000
Other Direct Research Costs: *	8,518,444	8,070,000	9,770,000
Indirect Costs:	17,100,000	18,900,000	21,760,000
TOTAL	$67,628,444	$80,000,000	$92,090,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Materials Research

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$76,879,972	$92,723,000	$107,300,000
Applied Research	4,200,000	4,800,000	5,700,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	81,079,972	97,523,000	113,000,000
(Conduct of R&D Performed by Universities and Colleges)	(79,400,000)	(95,400,000)	(110,500,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	81,079,972	97,523,000	113,000,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$81,079,972	$97,523,000	$113,000,000

Quantitative Data Table: Materials Research

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,328	1,375	1,425
Dollars Requested (Total)	$286,100,000	$320,000,000	$360,000,000
Action Summary			
Number of Awards	815	864	894
Dollars Obligated (Total)	81,079,972	97,523,000	113,000,000
Average Award Size	99,485	112,874	126,398
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	79,400,000	95,400,000	110,500,000
Industry	679,972	823,000	1,000,000
Federal Agencies	700,000	900,000	1,000,000
Other	300,000	400,000	500,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	1,181	1,244	1,269
Amount of Scientist Support	8,400,000	9,300,000	9,900,000
Number of Years of Scientist Support	180	183	186
Postdoctoral Support:			
Number of Postdoctorals Supported	430	460	475
Amount Postdoctoral Support	5,600,000	6,700,000	7,500,000
Graduate Students:			
Number of Students Supported	1,400	1,450	1,500
Amount Graduate Student Support	11,300,000	12,200,000	13,000,000
Other Personnel Costs:			
Amount of Support	6,900,000	8,700,000	10,000,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	13,800,000	19,500,000	24,700,000
Other Direct Research Costs:*	14,379,972	16,523,000	19,400,000
Indirect Costs:	20,700,000	24,600,000	28,500,000
TOTAL	$81,079,972	$97,523,000	$113,000,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Engineering

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$86,825,614	$103,063,818	$126,043,534
Applied Research	15,185,485	17,659,182	21,056,466
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	102,011,099	120,723,000	147,100,000
(Conduct of R&D Performed by Universities and Colleges)	(94,547,161)	(113,173,000)	(136,750,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	102,011,099	120,723,000	147,100,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$102,011,099	$120,723,000	$147,100,000

Quantitative Data Table: Engineering

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	5,139	5,700	6,400
Dollars Requested (Total)	$511,402,339	$592,000,000	$695,000,000
Action Summary			
Number of Awards	1,756	1,910	1,999
Dollars Obligated (Total)	102,011,099	120,723,000	147,100,000
Average Award Size	58,093	63,206	73,587
Average Award Duration (Years)	1.4	1.4	1.4
Dollar Distribution of Funds by Performer			
Universities	94,947,795	113,973,000	139,950,000
Industry	3,034,111	3,250,000	3,450,000
Federal Agencies	564,604	500,000	500,000
Other	3,464,589	3,000,000	3,200,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	1,932	2,165	2,360
Amount of Scientist Support	18,289,485	21,050,000	25,650,000
Number of Years of Scientist Support	406	451	527
Postdoctoral Support:			
Number of Postdoctorals Supported	153	175	194
Amount Postdoctoral Support	1,726,172	2,050,000	2,400,000
Graduate Students:			
Number of Students Supported	1,785	2,155	2,512
Amount Graduate Student Support	17,608,431	22,300,000	27,100,000
Other Personnel Costs:			
Amount of Support	11,299,603	11,900,000	14,310,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	400,634	800,000	3,200,000
Other Equipment and Instrumentation	8,316,932	17,400,000	20,800,000
Other Direct Research Costs: *	16,745,012	14,438,000	16,330,000
Indirect Costs:	27,624,830	30,785,000	37,310,000
TOTAL	$102,011,099	$120,723,000	$147,100,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Electrical, Computer, and Systems Engineering

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$25,790,151	$31,413,456	$39,164,765
Applied Research	3,740,468	4,563,544	5,565,235
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	29,530,619	35,977,000	44,730,000
(Conduct of R&D Performed by Universities and Colleges)	(28,141,925)	(34,777,000)	(42,630,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	29,530,619	35,977,000	44,730,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$29,530,619	$35,977,000	$44,730,000

Quantitative Data Table: Electrical, Computer, and Systems Engineering

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,326	1,550	1,850
Dollars Requested (Total)	$142,524,145	$175,000,000	$220,000,000
Action Summary			
Number of Awards	489	540	558
Dollars Obligated (Total)	29,530,619	35,977,000	44,730,000
Average Award Size	60,390	66,624	80,161
Average Award Duration (Years)	1.3	1.4	1.4
Dollar Distribution of Funds by Performer			
Universities	28,348,246	34,977,000	43,730,000
Industry	162,843	200,000	200,000
Federal Agencies	113,454	100,000	100,000
Other	906,076	700,000	700,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	606	680	730
Amount of Scientist Support	5,754,555	6,800,000	8,400,000
Number of Years of Scientist Support	126	142	170
Postdoctoral Support:			
Number of Postdoctorals Supported	38	45	55
Amount Postdoctoral Support	323,398	400,000	500,000
Graduate Students:			
Number of Students Supported	569	700	830
Amount Graduate Student Support	5,253,486	6,800,000	8,300,000
Other Personnel Costs:			
Amount of Support	3,172,271	3,500,000	4,200,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	206,321	200,000	1,100,000
Other Equipment and Instrumentation	2,599,766	6,100,000	7,400,000
Other Direct Research Costs:*	3,908,228	2,577,000	2,930,000
Indirect Costs:	8,312,594	9,600,000	11,900,000
TOTAL	$29,530,619	$35,977,000	$44,730,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Chemical and Process Engineering

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$20,205,665	$23,850,973	$29,250,482
Applied Research	2,353,951	2,732,027	3,279,518
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	22,559,616	26,583,000	32,530,000
(Conduct of R&D Performed by Universities and Colleges)	(21,756,602)	(25,483,000)	(30,580,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	22,559,616	26,583,000	32,530,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$22,559,616	$26,583,000	$32,530,000

Quantitative Data Table: Chemical and Process Engineering

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,350	1,450	1,650
Dollars Requested (Total)	$135,286,490	$152,000,000	$180,000,000
Action Summary			
Number of Awards	514	540	553
Dollars Obligated (Total)	22,559,616	26,583,000	32,530,000
Average Award Size	43,890	49,228	58,825
Average Award Duration (Years)	1.3	1.4	1.4
Dollar Distribution of Funds by Performer			
Universities	21,756,602	25,883,000	31,680,000
Industry	242,543	200,000	250,000
Federal Agencies	25,824	—0—	—0—
Other	534,647	500,000	600,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	452	480	530
Amount of Scientist Support	3,469,480	3,800,000	4,700,000
Number of Years of Scientist Support	78	81	95
Postdoctoral Support:			
Number of Postdoctorals Supported	45	55	55
Amount Postdoctoral Support	531,093	700,000	800,000
Graduate Students:			
Number of Students Supported	481	575	680
Amount Graduate Student Support	4,570,020	5,700,000	7,000,000
Other Personnel Costs:			
Amount of Support	2,105,406	2,200,000	2,700,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	400,000	1,100,000
Other Equipment and Instrumentation	2,262,886	4,200,000	5,000,000
Other Direct Research Costs: *	3,645,275	3,083,000	3,500,000
Indirect Costs:	5,975,456	6,500,000	7,730,000
TOTAL	$22,559,616	$26,583,000	$32,530,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Civil and Environmental Engineering

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$23,359,186	$25,875,168	$30,543,403
Applied Research	7,130,161	7,902,832	9,216,597
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	30,489,347	33,778,000	39,760,000
(Conduct of R&D Performed by Universities and Colleges)	(25,946,270)	(29,278,000)	(34,660,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	30,489,347	33,778,000	39,760,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$30,489,347	$33,778,000	$39,760,000

Quantitative Data Table: Civil and Environmental Engineering

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,329	1,400	1,500
Dollars Requested (Total)	$128,242,458	$140,000,000	$155,000,000
Action Summary			
Number of Awards	449	475	508
Dollars Obligated (Total)	30,489,347	33,778,000	39,760,000
Average Award Size	67,905	71,112	78,268
Average Award Duration (Years)	1.4	1.4	1.4
Dollar Distribution of Funds by Performer			
Universities	26,140,583	29,478,000	35,260,000
Industry	2,434,772	2,600,000	2,700,000
Federal Agencies	380,614	400,000	400,000
Other	1,533,378	1,300,000	1,400,000
Personel			
Senior Scientists:			
Number of Scientists Supported	535	595	650
Amount of Scientist Support	5,286,867	5,800,000	6,800,000
Number of Years of Scientist Support	121	131	146
Postdoctoral Support:			
Number of Postdoctorals Supported	37	38	45
Amount Postdoctoral Support	489,773	500,000	600,000
Graduate Students:			
Number of Students Supported	425	490	550
Amount Graduate Student Support	4,412,033	5,300,000	6,300,000
Other Personnel Costs:			
Amount of Support	3,968,375	3,800,000	4,460,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	194,313	200,000	600,000
Other Equipment and Instrumentation	1,664,599	3,400,000	4,000,000
Other Direct Research Costs: *	6,289,959	6,178,000	6,900,000
Indirect Costs:	8,183,428	8,600,000	10,100,000
TOTAL	$30,489,347	$33,778,000	$39,760,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Quantitative Data Table: Earthquake Hazard Mitigation

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	334	400	450
Dollars Requested (Total)	$41,932,781	$52,000,000	$62,000,000
Action Summary			
Number of Awards	190	185	200
Dollars Obligated (Total)	17,469,026	17,600,000	19,960,000
Average Award Size	91,942	95,135	99,800
Average Award Duration (Years)	1.4	1.4	1.4
Dollar Distribution of Funds by Performer			
Universities	14,016,945	14,100,000	15,960,000
Industry	2,157,196	2,200,000	2,600,000
Federal Agencies	180,600	200,000	200,000
Other	1,114,285	1,100,000	1,200,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	292	280	310
Amount of Scientist Support	2,977,934	3,000,000	3,500,000
Number of Years of Scientist Support	70	68	75
Postdoctoral Support:			
Number of Postdoctorals Supported	18	16	18
Amount Postdoctoral Support	325,191	300,000	350,000
Graduate Students:			
Number of Students Supported	194	190	218
Amount Graduate Student Support	2,037,750	2,100,000	2,500,000
Other Personnel Costs:			
Amount of Support	2,505,825	2,300,000	2,550,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	884,958	1,750,000	1,950,000
Other Direct Research Costs:*	3,905,716	3,500,000	3,860,000
Indirect Costs:	4,831,652	4,650,000	5,250,000
TOTAL	$17,469,026	$17,600,000	$19,960,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Mechanical Engineering and Applied Mechanics

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$17,470,612	$21,924,221	$27,084,884
Applied Research	1,960,905	2,460,779	2,995,116
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	19,431,517	24,385,000	30,080,000
(Conduct of R&D Performed by Universities and Colleges)	(18,702,364)	(23,635,000)	(28,880,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	19,431,517	24,385,000	30,080,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$19,431,517	$24,385,000	$30,080,000

Quantitative Data Table: Mechanical Engineering and Applied Mechanics

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,134	1,300	1,400
Dollars Requested (Total)	$105,349,246	$125,000,000	$140,000,000
Action Summary			
Number of Awards	304	355	380
Dollars Obligated (Total)	19,431,517	24,385,000	30,080,000
Average Award Size	63,919	68,690	79,158
Average Award Duration (Years)	1.4	1.4	1.4
Dollar Distribution of Funds by Performer			
Universities	18,702,364	23,635,000	29,280,000
Industry	193,953	250,000	300,000
Federal Agencies	44,712	—0—	—0—
Other	490,488	500,000	500,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	339	410	450
Amount of Scientist Support	3,778,583	4,650,000	5,750,000
Number of Years of Scientist Support	81	97	116
Postdoctoral Support:			
Number of Postdoctorals Supported	33	37	39
Amount Postdoctoral Support	381,908	450,000	500,000
Graduate Students:			
Number of Students Supported	310	390	452
Amount Graduate Student Support	3,372,892	4,500,000	5,500,000
Other Personnel Costs:			
Amount of Support	2,053,551	2,400,000	2,950,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	400,000
Other Equipment and Instrumentation	1,789,681	3,700,000	4,400,000
Other Direct Research Costs: *	2,901,550	2,600,000	3,000,000
Indirect Costs:	5,153,352	6,085,000	7,580,000
TOTAL	$19,431,517	$24,385,000	$30,080,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Biological, Behavorial and Social Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$177,315,594	$208,808,000	$237,270,000
Applied Research	15,775,030	15,850,000	15,850,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	193,090,624	224,658,000	253,120,000
(Conduct of R&D Performed by Universities and Colleges)	(169,908,772)	(197,548,696)	(222,550,160)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	193,090,624	224,658,000	253,120,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$193,090,624	$224,658,000	$253,120,000

Quantitative Data Table: Biological, Behavorial and Social Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	9,212	10,727	12,085
Dollars Requested (Total)	$1,578,482,265	$1,843,411,599	$2,078,707,802
Action Summary			
Number of Awards	3,428	3,517	3,560
Dollars Obligated (Total)	193,090,624	224,658,000	253,120,000
Average Award Size	56,327	63,878	71,101
Average Award Duration (Years)	1.3	1.3	1.3
Dollar Distribution of Funds by Performer			
Universities	169,908,772	197,548,696	222,550,160
Industry	877,940	1,020,290	1,146,680
Federal Agencies	2,059,363	2,399,906	2,705,320
Other	20,244,549	23,689,108	26,717,840
Personnel			
Senior Scientists:			
Number of Scientists Supported	2,982	3,147	3,326
Amount of Scientist Support	27,747,777	31,597,587	35,433,891
Number of Years of Scientist Support	857	910	953
Postdoctoral Support:			
Number of Postdoctorals Supported	907	957	1,012
Amount Postdoctoral Support	11,107,739	12,545,128	14,181,319
Graduate Students:			
Number of Students Supported	1,779	1,888	1,982
Amount Graduate Student Support	11,099,559	12,587,604	14,129,867
Other Personnel Costs:			
Amount of Support	38,219,025	43,208,895	48,536,972
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	16,535,462	24,595,442	28,354,448
Other Direct Research Costs:*	38,269,092	43,355,674	48,692,283
Indirect Costs:	50,111,970	56,767,670	63,791,220
TOTAL	$193,090,624	$224,658,000	$253,120,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Physiology, Cellular and Molecular Biology

	Actual FY 1983	Estimate FY 1984	Estimate FY 1985
Support of R&D			
Conduct of R&D:			
Basic Research	$82,976,369	$97,658,000	$111,960,000
Applied Research	4,367,177	4,400,000	4,400,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	87,343,546	102,058,000	116,360,000
(Conduct of R&D Performed by Universities and Colleges)	(79,657,314)	(93,076,896)	(106,120,320)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	87,343,546	102,058,000	116,360,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$87,343,546	$102,058,000	$116,360,000

Quantitative Data Table: Physiology, Cellular, and Molecular Biology

	Actual FY 1983	Estimate FY 1984	Estimate FY 1985
Proposal Summary			
Number of Proposals Received	4,302	5,045	5,752
Dollars Requested (Total)	$855,380,417	$1,006,553,409	$1,147,607,779
Action Summary			
Number of Awards	1,491	1,532	1,550
Dollars Obligated (Total)	87,343,546	102,058,000	116,360,000
Average Award Size	58,581	66,617	75,071
Average Award Duration (Years)	1.2	1.2	1.2
Dollar Distribution of Funds by Performer			
Universities	79,657,314	93,076,896	106,120,320
Industry	436,718	510,290	581,800
Federal Agencies	611,405	714,406	814,520
Other	6,638,109	7,756,408	8,843,360
Personnel			
Senior Scientists:			
Number of Scientists Supported	1,161	1,229	1,309
Amount of Scientist Support	9,115,116	10,324,403	11,771,223
Number of Years of Scientist Support	314	333	355
Postdoctoral Support:			
Number of Postdoctorals Supported	641	678	723
Amount Postdoctoral Support	7,743,442	8,770,751	9,999,849
Graduate Students:			
Number of Students Supported	758	803	855
Amount Graduate Student Support	4,471,338	5,064,543	5,774,268
Other Personnel Costs:			
Amount of Support	16,761,763	18,985,517	21,646,072
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	10,217,700	14,700,000	16,759,999
Other Direct Research Costs: *	15,774,862	17,867,686	20,371,592
Indirect Costs:	23,259,325	26,345,100	30,036,997
TOTAL	$87,343,546	$102,058,000	$116,360,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel, Fringe Benefits.

Research and Development Special Analysis: Biotic Systems and Resources

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$39,523,725	$47,000,000	$53,480,000
Applied Research	6,434,095	6,400,000	6,400,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	45,957,820	53,400,000	59,880,000
(Conduct of R&D Performed by Universities and Colleges)	(38,053,075)	(44,215,200)	(49,580,640)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	45,957,820	53,400,000	59,880,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$45,957,820	$53,400,000	$59,880,000

Quantitative Data Table: Biotic Systems and Resources

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,567	1,821	2,041
Dollars Requested (Total)	$224,162,090	$260,476,340	$291,993,970
Action Summary			
Number of Awards	716	737	746
Dollars Obligated (Total)	45,957,820	53,400,000	59,880,000
Average Award Size	64,187	72,456	80,268
Average Award Duration (Years)	1.3	1.3	1.3
Dollar Distribution of Funds by Performer			
Universities	38,053,075	44,215,200	49,580,640
Industry	—0—	—0—	—0—
Federal Agencies	1,332,777	1,548,600	1,736,520
Other	6,571,968	7,636,200	8,562,840
Personnel			
Senior Scientists:			
Number of Scientists Supported	733	755	813
Amount of Scientist Support	5,966,827	6,754,612	7,574,273
Number of Years of Scientist Support	202	214	224
Postdoctoral Support:			
Number of Postdoctorals Supported	142	150	157
Amount Postdoctoral Support	1,924,912	2,179,053	2,443,477
Graduate Students:			
Number of Students Supported	406	429	450
Amount Graduate Student Support	2,670,682	3,023,285	3,390,156
Other Personnel Costs:			
Amount of Support	11,052,455	12,511,683	14,029,955
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	3,379,350	5,200,000	5,831,011
Other Direct Research Costs: *	10,472,154	11,854,766	13,293,322
Indirect Costs:	10,491,440	11,876,601	13,317,806
TOTAL	$45,957,820	$53,400,000	$59,880,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel, Fringe Benefits.

Research and Development Special Analysis: Behavioral and Neural Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$33,340,992	$37,800,000	$41,580,000
Applied Research	680,429	700,000	700,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	34,021,421	38,500,000	42,280,000
(Conduct of R&D Performed by Universities and Colleges)	(31,299,707)	(35,420,000)	(38,897,600)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	34,021,421	38,500,000	42,280,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$34,021,421	$38,500,000	$42,280,000

Quantitative Data Table: Behavioral and Neural Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,981	2,231*	2,450
Dollars Requested (Total)	$338,308,748	$382,965,500	$421,262,050
Action Summary			
Number of Awards	694	707	716
Dollars Obligated (Total)	34,021,421	38,500,000	42,280,000
Average Award Size	49,022	54,455	59,050
Average Award Duration (Years)	1.4	1.4	1.4
Dollar Distribution of Funds by Performer			
Universities	31,299,707	35,420,000	38,897,600
Industry	34,021	38,500	42,280
Federal Agencies	34,021	38,500	42,280
Other	2,653,672	3,003,000	3,297,840
Personnel			
Senior Scientists:			
Number of Scientists Supported	534	544	550
Amount of Scientist Support	5,846,117	6,377,054	6,890,915
Number of Years of Scientist Support	194	198	200
Postdoctoral Support:			
Number of Postdoctorals Supported	92	93	94
Amount Postdoctoral Support	1,127,687	1,230,103	1,329,224
Graduate Students:			
Number of Students Supported	300	306	309
Amount Graduate Student Support	1,900,239	2,072,817	2,239,844
Other Personnel Costs:			
Amount of Support	6,741,051	7,353,265	7,945,789
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	2,393,800	4,000,000	5,000,000
Other Direct Research Costs: *	6,959,046	7,591,056	8,202,743
Indirect Costs:	9,053,481	9,875,703	10,671,485
TOTAL	$34,021,421	$38,500,000	$42,280,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel, Fringe Benefits.

Research and Development Special Analysis: Social and Economic Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$16,434,908	$20,700,000	$24,100,000
Applied Research	3,855,102	3,900,000	3,900,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	20,290,010	24,600,000	28,000,000
(Conduct of R&D Performed by Universities and Colleges)	(15,826,208)	(19,188,000)	(21,840,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	20,290,010	24,600,000	28,000,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$20,290,010	$24,600,000	$28,000,000

Quantitative Data Table: Social and Economic Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,148	1,392	1,584
Dollars Requested (Total)	$126,250,046	$153,015,040	$174,131,110
Action Summary			
Number of Awards	462	474	480
Dollars Obligated (Total)	20,290,010	24,600,000	28,000,000
Average Award Size	43,918	51,899	58,333
Average Award Duration (Years)	1.5	1.5	1.5
Dollar Distribution of Funds by Performer			
Universities	15,826,208	19,188,000	21,840,000
Industry	182,610	221,400	252,000
Federal Agencies	81,160	98,400	112,000
Other	4,200,032	5,092,200	5,796,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	473	536	570
Amount of Scientist Support	5,698,997	6,909,574	7,864,556
Number of Years of Scientist Support	123	140	149
Postdoctoral Support:			
Number of Postdoctorals Supported	24	27	29
Amount Postdoctoral Support	199,604	242,003	275,451
Graduate Students:			
Number of Students Supported	249	282	300
Amount Graduate Student Support	1,462,203	1,772,803	2,017,824
Other Personnel Costs:			
Amount of Support	2,925,262	3,546,645	4,036,831
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	161,200	195,442	222,454
Other Direct Research Costs:*	4,211,696	5,106,341	5,812,096
Indirect Costs:	5,631,048	6,827,192	7,770,788
TOTAL	$20,290,010	$24,600,000	$28,000,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel, Fringe Benefits.

Research and Development Special Analysis: Information Science and Technology

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$5,039,600	$5,650,000	$6,150,000
Applied Research	438,227	450,000	450,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	5,477,827	6,100,000	6,600,000
(Conduct of R&D Performed by Universities and Colleges)	(5,072,468)	(5,648,600)	(6,111,600)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	5,477,827	6,100,000	6,600,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$5,477,827	$6,100,000	$6,600,000

Quantitative Data Table: Information Science and Technology

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	214	238	258
Dollars Requested (Total)	$34,380,964	$40,401,310	$43,712,893
Action Summary			
Number of Awards	65	67	68
Dollars Obligated (Total)	5,477,827	6,100,000	6,600,000
Average Award Size	84,274	91,045	97,059
Average Award Duration (Years)	1.4	1.4	1.4
Dollar Distribution of Funds by Performer			
Universities	5,072,468	5,648,600	6,111,600
Industry	224,591	250,100	270,600
Federal Agencies	—0—	—0—	—0—
Other	180,768	201,300	217,800
Personnel			
Senior Scientists:			
Number of Scientists Supported	81	83	84
Amount of Scientist Support	1,120,720	1,231,944	1,332,924
Number of Years of Scientist Support	24	25	25
Postdoctoral Support:			
Number of Postdoctorals Supported	8	9	9
Amount Postdoctoral Support	112,094	123,218	133,318
Graduate Students:			
Number of Students Supported	66	68	68
Amount Graduate Student Support	595,097	654,156	707,775
Other Personnel Costs:			
Amount of Support	738,494	811,785	878,325
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	383,412	500,000	540,984
Other Direct Research Costs: *	851,334	935,823	1,012,530
Indirect Costs:	1,676,676	1,843,074	1,994,144
TOTAL	$5,477,827	$6,100,000	$6,600,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel, Fringe Benefits.

Research and Development Special Analysis: Astronomical Atmospheric, Earth and Ocean Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$277,718,484	$325,882,000	$364,836,000
Applied Research	3,361,695	3,559,000	4,094,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	281,080,179	329,441,000	368,930,000
(Conduct of R&D Performed by Universities and Colleges)	(191,860,180)	(204,064,000)	(221,305,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	748,500	600,000	4,550,000
Total, Support of R&D	281,828,679	330,041,000	373,480,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$281,828,679	$330,041,000	$373,480,000

Quantitative Data Table: Astronomical Atmospheric, Earth and Ocean Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	3,748	4,104	4,405
Dollars Requested (Total)	$671,737,575	$757,902,145	$854,469,931
Action Summary			
Number of Awards	2,161	2,263	2,268
Dollars Obligated (Total)	281,828,679	330,041,000	373,480,000
Average Award Size	130,415	145,842	164,674
Average Award Duration (Years)	1.2	1.2	1.2
Dollar Distribution of Funds by Performer			
Universities	192,660,180	202,794,000	227,194,000
Industry	2,893,292	1,600,000	2,062,000
Federal Agencies	1,485,427	1,652,000	1,594,000
Other	84,789,780	123,995,000	142,630,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	2,431	2,555	2,654
Amount of Scientist Support	32,373,567	37,514,200	41,295,500
Number of Years of Scientist Support	818	905	977
Postdoctoral Support:			
Number of Postdoctorals Supported	442	477	503
Amount Postdoctoral Support	6,642,880	7,666,400	8,377,000
Graduate Students:			
Number of Students Supported	1,615	1,695	1,736
Amount Graduate Student Support	13,421,827	15,671,200	17,052,000
Other Personnel Costs:			
Amount of Support	68,727,525	77,136,500	81,145,500
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	748,500	600,000	4,550,000
Major Equipment	2,235,100	19,100,000	21,600,000
Other Equipment and Instrumentation	22,090,799	29,750,000	32,870,000
Other Direct Research Costs: *	94,610,909	96,690,600	116,414,000
Indirect Costs:	40,977,572	45,912,100	50,176,000
TOTAL	$281,828,679	$330,041,000	$373,480,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Astronomical Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$62,718,773	$78,150,000	$91,100,000
Applied Research	—0—	—0—	—0—
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	62,718,773	78,150,000	91,100,000
(Conduct of R&D Performed by Universities and Colleges)*	(20,569,173)	(26,428,000)	(27,640,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	2,300,000
Total, Support of R&D	62,718,773	78,150,000	93,400,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$62,718,773	$78,150,000	$93,400,000

* Does not include National Centers.

Quantitative Data Table: Astronomical Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	409	503	533
Dollars Requested (Total)	$105,964,611	$130,450,000	$149,500,000
Action Summary			
Number of Awards	240	260	261
Dollars Obligated (Total)	62,718,773	78,150,000	93,400,000
Average Award Size	261,328	300,577	357,854
Average Award Duration (Years)	1.1	1.1	1.1
Dollar Distribution of Funds by Performer			
Universities	20,569,173	26,428,000	27,561,000
Industry	146,600	200,000	210,000
Federal Agencies	60,000	72,000	79,000
Other	41,943,000	51,450,000	65,550,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	394	429	431
Amount of Scientist Support	7,302,419	8,848,000	9,256,000
Number of Years of Scientist Support	176	204	204
Postdoctoral Support:			
Number of Postdoctorals Supported	105	112	112
Amount Postdoctoral Support	1,873,324	2,187,000	2,278,000
Graduate Students:			
Number of Students Supported	217	211	220
Amount Graduate Student Support	1,789,434	1,860,000	1,941,000
Other Personnel Costs:			
Amount of Support	23,639,527	26,835,000	28,027,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	2,300,000
Major Equipment[1]	235,100	4,700,000	14,900,000
Other Equipment and Instrumentation[2]	5,768,358	8,185,000	7,795,000
Other Direct Research Costs:[3]	15,597,311	17,346,500	18,357,000
Indirect Costs:	6,513,300	8,188,500	8,546,000
TOTAL	$62,718,773	$78,150,000	$93,400,000

[1] Includes salaries, supplies, and other costs for constructed equipment

[2] Does not include salaries, supplies, and other costs for constructed equipment.

[3] Includes fringe benefits, supplies, publications, and travel.

Quantitative Data Table: Astronomy Project Support

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	406	500	530
Dollars Requested (Total)	$64,765,611	$80,000,000	$85,000,000
Action Summary			
Number of Awards	237	257	258
Dollars Obligated (Total)	21,519,773	27,700,000	28,900,000
Average Award Size	90,801	107,782	112,016
Average Award Duration (Years)	1.2	1.2	1.2
Dollar Distribution of Funds by Performer			
Universities	20,569,173	26,428,000	27,561,000
Industry	146,600	200,000	210,000
Federal Agencies	60,000	72,000	79,000
Other	744,000	1,000,000	1,050,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	300	327	329
Amount of Scientist Support	2,859,419	3,800,000	3,964,000
Number of Years of Scientist Support	82	102	102
Postdoctoral Support:			
Number of Postdoctorals Supported	87	92	92
Amount Postdoctoral Support	1,448,324	1,693,000	1,761,000
Graduate Students:			
Number of Students Supported	201	195	195
Amount Graduate Student Support	1,735,434	1,772,000	1,843,000
Other Personnel Costs:			
Amount of Support	2,516,527	2,907,000	3,041,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment[1]	235,100	2,200,000	2,200,000
Other Equipment and Instrumentation[2]	1,996,358	2,331,000	2,437,000
Other Direct Research Costs:[3]	5,481,311	6,397,000	6,744,000
Indirect Costs:	5,247,300	6,600,000	6,910,000
TOTAL	$21,519,773	$27,700,000	$28,900,000

[1] Includes salaries, supplies, and other costs for constructed equipment.

[2] Does not include salaries, supplies, and other costs for constructed equipment.

[3] Includes fringe benefits, supplies, publications, and travel.

Quantitative Data Table: National Astronomy and Ionosphere Center

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1	1	1
Dollars Requested (Total)	$5,110,000	$6,200,000	$6,300,000
Action Summary			
Number of Awards	1	1	1
Dollars Obligated (Total)	5,110,000	6,200,000	6,300,000
Average Award Size	5,110,000	6,200,000	6,300,000
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	—0—	—0—	—0—
Industry	—0—	—0—	—0—
Federal Agencies	—0—	—0—	—0—
Other	5,110,000	6,200,000	6,300,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	7	9	9
Amount of Scientist Support	312,000	435,000	466,000
Number of Years of Scientist Support	7	9	9
Postdoctoral Support:			
Number of Postdoctorals Supported	—0—	—0—	—0—
Amount Postdoctoral Support	—0—	—0—	—0—
Graduate Students:			
Number of Students Supported	4	4	6
Amount Graduate Student Support	10,000	10,000	20,000
Other Personnel Costs:			
Amount of Support	2,786,000	3,130,000	3,174,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation[1]	253,000	467,000	400,000
Other Direct Research Costs:[2]	1,183,000	1,362,000	1,420,000
Indirect Costs:	566,000	796,000	820,000
TOTAL	$5,110,000	$6,200,000	$6,300,000

[1] Does not include salaries, supplies, and other costs for constructed equipment.

[2] Includes operation and maintenance of facilities, computer lease and maintenance, supplies, services, utilities, communications, and travel.

Quantitative Data Table: Kitt Peak National/Cerro Tololo Inter-American/NSO Observatories

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1	1	1
Dollars Requested (Total)	$20,189,000	$23,650,000	$24,800,000
Action Summary			
Number of Awards	1	1	1
Dollars Obligated (Total)	20,189,000	23,650,000	24,800,000
Average Award Size	20,189,000	23,650,000	24,800,000
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	—0—	—0—	—0—
Industry	—0—	—0—	—0—
Federal Agencies	—0—	—0—	—0—
Other	20,189,000	23,650,000	24,800,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	52	58	58
Amount of Scientist Support	2,460,000	2,841,000	2,965,000
Number of Years of Scientist Support	52	58	58
Postdoctoral Support:			
Number of Postdoctorals Supported	6	8	8
Amount Postdoctoral Support	135,000	187,000	195,000
Graduate Students:			
Number of Students Supported	10	9	16
Amount Graduate Student Support	28,000	52,000	50,000
Other Personnel Costs:			
Amount of Support	9,997,000	11,386,000	11,929,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation[1]	2,202,000	3,554,000	3,602,000
Other Direct Research Costs:[2]	4,982,000	5,167,500	5,573,000
Indirect Costs:[3]	385,000	462,500	486,000
TOTAL	$20,189,000	$23,650,000	$24,800,000

[1] Does not include salaries, supplies, or other costs for constructed equipment.

[2] Includes operation and maintenace of facilities, computer lease and maintenace, supplies, services, utilities, communications, and travel.

[3] Management fee of the AURA consortium.

Quantitative Data Table: National Radio Astronomy Observatory

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1	1	1
Dollars Requested (Total)	$15,900,000	$20,600,000	$33,400,000
Action Summary			
Number of Awards	1	1	1
Dollars Obligated (Total)	15,900,000	20,600,000	33,400,000
Average Award Size	15,900,000	20,600,000	33,400,000
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	—0—	—0—	—0—
Industry	—0—	—0—	—0—
Federal Agencies	—0—	—0—	—0—
Other	15,900,000	20,600,000	33,400,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	35	35	35
Amount of Scientist Support	1,671,000	1,772,000	1,861,000
Number of Years of Scientist Support	35	35	35
Postdoctoral Support:			
Number of Postdoctorals Supported	12	12	12
Amount Postdoctoral Support	290,000	307,000	322,000
Graduate Students:			
Number of Students Supported	2	3	3
Amount Graduate Student Support	16,000	26,000	28,000
Other Personnel Costs:			
Amount of Support	8,340,000	9,412,000	9,883,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment[1]	—0—	—0—	2,300,000
Major Equipment[1]	—0—	2,500,000	12,700,000
Other Equipment and Instrumentation[2]	1,317,000	1,833,000	1,356,000
Other Direct Research Costs:[3]	3,951,000	4,420,000	4,620,000
Indirect Costs:[4]	315,000	330,000	330,000
TOTAL	$15,900,000	$20,600,000	$33,400,000

[1] VLBA design and construction.

[2] Does not include salaries, supplies, or other costs for constructed equipment

[3] Includes operation and maintenance of facilities, building rental, computer lease and maintenance, supplies, services, utilities, communications, and travel.

[4] Management fee of the AUI consortium.

Research and Development Special Analysis: Atmospheric Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$74,114,353	$87,600,000	$95,340,000
Applied Research	900,000	1,100,000	1,200,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	75,014,353	88,700,000	96,540,000
(Conduct of R&D Performed by Universities and Colleges)	(34,500,000)	(39,600,000)	(43,420,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	500,000	600,000	2,000,000
Total, Support of R&D	75,514,353	89,300,000	98,540,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$75,514,353	$89,300,000	$98,540,000

Quantitative Data Table: Atmospheric Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	890	960	1,036
Dollars Requested (Total)	$187,695,889	$218,452,145	$250,969,931
Action Summary			
Number of Awards	519	550	551
Dollars Obligated (Total)	75,514,353	89,300,000	98,540,000
Average Award Size	145,500	162,364	178,838
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	34,500,000	39,600,000	43,420,000
Industry	1,100,000	1,200,000	1,000,000
Federal Agencies	1,000,000	1,000,000	800,000
Other	38,914,353	47,500,000	53,320,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	795	849	866
Amount of Scientist Support	12,233,544	14,285,200	15,400,000
Number of Years of Scientist Support	282	312	314
Postdoctoral Support:			
Number of Postdoctorals Supported	154	164	170
Amount Postdoctoral Support	2,430,000	2,795,400	2,900,000
Graduate Students:			
Number of Students Supported	415	447	455
Amount Graduate Student Support	3,489,500	4,062,200	4,380,000
Other Personnel Costs:			
Amount of Support	19,506,798	21,392,000	22,800,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	500,000	600,000	2,000,000
Major Equipment	2,000,000	3,900,000	6,700,000
Other Equipment and Instrumentation	5,595,637	9,100,000	9,979,000
Other Direct Research Costs: *	19,400,237	21,797,600	22,260,000
Indirect Costs:	10,358,637	11,367,600	12,121,000
TOTAL	$75,514,353	$89,300,000	$98,540,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Quantitative Data Table: Atmospheric Sciences Project Support

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	884	955	1,031
Dollars Requested (Total)	$148,170,875	$171,276,385	$197,849,931
Action Summary			
Number of Awards	514	545	546
Dollars Obligated (Total)	39,650,001	45,500,000	48,520,000
Average Award Size	77,140	83,486	88,865
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	32,600,000	37,300,000	41,120,000
Industry	1,100,000	1,200,000	1,000,000
Federal Agencies	1,000,000	1,000,000	800,000
Other	4,950,001	6,000,000	5,600,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	683	719	735
Amount of Scientist Support	6,800,500	7,385,200	7,900,000
Number of Years of Scientist Support	173	185	186
Postdoctoral Support:			
Number of Postdoctorals Supported	138	144	150
Amount Postdoctoral Support	2,030,000	2,295,400	2,400,000
Graduate Students:			
Number of Students Supported	401	432	440
Amount Graduate Student Support	3,349,500	3,892,200	4,200,000
Other Personnel Costs:			
Amount of Support	3,755,500	3,992,000	4,300,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	3,806,250	6,000,000	7,279,000
Other Direct Research Costs: *	10,048,500	11,167,600	10,920,000
Indirect Costs:	9,859,751	10,767,600	11,521,000
TOTAL	$39,650,001	$45,500,000	$48,520,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Quantitative Data Table: National Center for Atmospheric Research

	Actual *FY 1983*	*Estimate* *FY 1984*	*Estimate* *FY 1985*
Proposal Summary			
Number of Proposals Received	1	1	1
Dollars Requested (Total)	$32,400,000	$40,000,000	$45,920,000
Action Summary			
Number of Awards	1	1	1
Dollars Obligated (Total)	32,400,000	40,000,000	45,920,000
Average Award Size	32,400,000	40,000,000	45,920,000
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	—0—	—0—	—0—
Industry	—0—	—0—	—0—
Federal Agencies	—0—	—0—	—0—
Other	32,400,000	40,000,000	45,920,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	100	118	118
Amount of Scientist Support	5,000,000	6,500,000	6,900,000
Number of Years of Scientist Support	100	118	118
Postdoctoral Support:			
Number of Postdoctorals Supported	15	19	19
Amount Postdoctoral Support	400,000	500,000	500,000
Graduate Students:			
Number of Students Supported	14	15	15
Amount Graduate Student Support	140,000	170,000	180,000
Other Personnel Costs:			
Amount of Support	15,100,000	16,700,000	17,700,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	1,400,000
Major Equipment	2,000,000	3,800,000	6,600,000
Other Equipment and Instrumentation	1,600,000	2,900,000	2,500,000
Other Direct Research Costs: *	8,160,000	9,430,000	10,140,000
Indirect Costs:	—0—	—0—	—0—
TOTAL	$32,400,000	$40,000,000	$45,920,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Quantitative Data Table: Upper Atmospheric Research Facilities

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	5	4	4
Dollars Requested (Total)	$7,125,014	$7,175,760	$7,200,000
Action Summary			
Number of Awards	4	4	4
Dollars Obligated (Total)	3,464,352	3,800,000	4,100,000
Average Award Size	866,088	950,000	1,025,000
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	1,900,000	2,300,000	2,300,000
Industry	—0—	—0—	—0—
Federal Agencies	—0—	—0—	—0—
Other	1,564,352	1,500,000	1,800,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	12	12	13
Amount of Scientist Support	433,044	400,000	600,000
Number of Years of Scientist Support	9	9	10
Postdoctoral Support:			
Number of Postdoctorals Supported	1	1	1
Amount Postdoctoral Support	—0—	—0—	—0—
Graduate Students:			
Number of Students Supported	—0—	—0—	—0—
Amount Graduate Student Support	—0—	—0—	—0—
Other Personnel Costs:			
Amount of Support	651,298	700,000	800,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	500,000	600,000	600,000
Major Equipment	—0—	100,000	100,000
Other Equipment and Instrumentation	189,387	200,000	200,000
Other Direct Research Costs:*	1,191,737	1,200,000	1,200,000
Indirect Costs:	498,886	600,000	600,000
TOTAL	$3,464,352	$3,800,000	$4,100,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Earth Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$32,795,280	$39,500,000	$46,200,000
Applied Research	2,052,700	2,000,000	2,400,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	34,847,980	41,500,000	48,600,000
(Conduct of R&D Performed by Universities and Colleges)	(34,081,898)	(40,800,000)	(47,700,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	34,847,980	41,500,000	48,600,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$34,847,980	$41,500,000	$48,600,000

Quantitative Data Table: Earth Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,201	1 215	1,250
Dollars Requested (Total)	$147,347,379	$123,500,000	$140,000,000
Action Summary			
Number of Awards	624	643	644
Dollars Obligated (Total)	34,847,980	41,500,000	48,600,000
Average Award Size	55,846	64,541	75,466
Average Award Duration (Years)	1.5	1.5	1.5
Dollar Distribution of Funds by Performer			
Universities	34,081,898	40,800,000	47,700,000
Industry	5,000	—0—	—0—
Federal Agencies	9,800	—0—	—0—
Other	751,282	700,000	900,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	650	643	644
Amount of Scientist Support	4,708,406	5,500,000	6,200,000
Number of Years of Scientist Support	128	150	190
Postdoctoral Support:			
Number of Postdoctorals Supported	84	90	100
Amount Postdoctoral Support	1,018,457	1,200,000	1,400,000
Graduate Students:			
Number of Students Supported	611	643	644
Amount Graduate Student Support	4,870,297	6,200,000	6,800,000
Other Personnel Costs:			
Amount of Support	2,060,387	2,600,000	3,000,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	4,724,800	5,000,000	6,000,000
Other Direct Research Costs: *	8,614,706	12,100,000	14,700,000
Indirect Costs:	8,850,927	8,900,000	10,500,000
TOTAL	$34,847,980	$41,500,000	$48,600,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Ocean Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$102,076,829	$113,485,000	$124,460,000
Applied Research	204,000	215,000	230,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	102,280,829	113,700,000	124,690,000
(Conduct of R&D Performed by Universities and Colleges)	(96,713,286)	(90,100,000)	(94,815,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	248,500	—0—	250,000
Total, Support of R&D	102,529,329	113,700,000	124,940,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$102,529,329	$113,700,000	$124,940,000

Quantitative Data Table: Ocean Sciences

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	1,131	1,301	1,456
Dollars Requested (Total)	$230,690,094	$265,500,000	$293,000,000
Action Summary			
Number of Awards	710	730	732
Dollars Obligated (Total)	102,529,329	113,700,000	124,940,000
Average Award Size	144,408	155,753	170,683
Average Award Duration (Years)	1.1	1.1	1.1
Dollar Distribution of Funds by Performer			
Universities	97,513,286	88,830,000	100,783,000
Industry	1,641,692	200,000	852,000
Federal Agencies	351,393	500,000	625,000
Other	3,022,958	24,170,000	22,680,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	499	523	593
Amount of Scientist Support	7,262,898	7,850,000	9,325,000
Number of Years of Scientist Support	207	209	237
Postdoctoral Support:			
Number of Postdoctorals Supported	89	99	108
Amount Postdoctoral Support	1,166,499	1,300,000	1,600,000
Graduate Students:			
Number of Students Supported	321	333	351
Amount Graduate Student Support	2,859,898	3,050,000	3,400,000
Other Personnel Costs:			
Amount of Support	22,555,658	25,161,000	26,077,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	248,500	—0—	250,000
Major Equipment	—0—	10,500,000	—0—
Other Equipment and Instrumentation	5,779,204	7,200,000	8,810,000
Other Direct Research Costs: *	48,886,566	42,950,000	58,379,000
Indirect Costs:	13,770,108	15,689,000	17,099,000
TOTAL	$102,529,329	$113,700,000	$124,940,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Quantitative Data Table: Ocean Sciences Research Support

	Actual *FY 1983*	*Estimate* *FY 1984*	*Estimate* *FY 1985*
Proposal Summary			
Number of Proposals Received	966	1,125	1,275
Dollars Requested (Total)	$157,067,960	$180,000,000	$210,000,000
Action Summary			
Number of Awards	585	598	592
Dollars Obligated (Total)	49,917,291	54,600,000	60,900,000
Average Award Size	85,329	91,304	102,872
Average Award Duration (Years)	1.2	1.2	1.2
Dollar Distribution of Funds by Performer			
Universities	49,195,678	53,850,000	59,900,000
Industry	171,692	200,000	300,000
Federal Agencies	46,963	50,000	100,000
Other	502,958	500,000	600,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	492	510	525
Amount of Scientist Support	6,887,898	7,400,200	8,200,000
Number of Years of Scientist Support	200	200	215
Postdoctoral Support:			
Number of Postdoctorals Supported	89	95	100
Amount Postdoctoral Support	1,166,499	1,200,000	1,400,000
Graduate Students:			
Number of Students Supported	319	330	345
Amount Graduate Student Support	2,829,896	3,000,000	3,300,000
Other Personnel Costs:			
Amount of Support	7,571,639	8,200,000	9,100,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	2,191,604	3,700,000	4,600,000
Other Direct Research Costs:*	18,193,057	19,200,000	21,200,000
Indirect Costs:	11,076,698	11,900,000	13,100,000
TOTAL	$49,917,291	$54,600,000	$60,900,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Quantitative Data Table: Oceanographic Facilities Support

	Actual *FY 1983*	*Estimate* *FY 1984*	*Estimate* *FY 1985*
Proposal Summary			
Number of Proposals Received	135	140	145
Dollars Requested (Total)	$43,622,134	$45,500,000	$46,500,000
Action Summary			
Number of Awards	100	110	115
Dollars Obligated (Total)	31,612,038	32,800,000	36,440,000
Average Award Size	316,120	298,182	316,870
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	31,517,608	32,350,000	35,915,000
Industry	—0—	—0—	—0—
Federal Agencies	94,430	450,000	525,000
Other	—0—	—0—	—0—
Personnel			
Senior Scientists:			
Number of Scientists Supported	—0—	—0—	—0—
Amount of Scientist Support	—0—	—0—	—0—
Number of Years of Scientist Support	—0—	—0—	—0—
Postdoctoral Support:			
Number of Postdoctorals Supported	—0—	—0—	—0—
Amount Postdoctoral Support	—0—	—0—	—0—
Graduate Students:			
Number of Students Supported	—0—	—0—	—0—
Amount Graduate Student Support	—0—	—0—	—0—
Other Personnel Costs:			
Amount of Support	11,909,019	12,641,000	13,400,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	248,500	—0—	250,000
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	3,587,600	3,500,000	4,210,000
Other Direct Research Costs: *	13,473,509	13,500,000	14,946,000
Indirect Costs:	2,393,410	3,159,000	3,634,000
TOTAL	$31,612,038	$32,800,000	$36,440,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Quantitative Data Table: Ocean Drilling Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	30	36	36
Dollars Requested (Total)	$30,000,000	$40,000,000	$36,500,000
Action Summary			
Number of Awards	25	22	25
Dollars Obligated (Total)	21,000,000	26,300,000	27,600,000
Average Award Size	840,000	1,195,455	1,104,000
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	16,800,000	2,530,000	4,968,000
Industry	1,470,000	—0—	552,000
Federal Agencies	210,000	—0—	—0—
Other	2,520,000	23,670,000	22,080,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	7	13	68
Amount of Scientist Support	375,000	450,000	1,125,000
Number of Years of Scientist Support	7	9	22
Postdoctoral Support:			
Number of Postdoctorals Supported	—0—	4	8
Amount Postdoctoral Support	—0—	100,000	200,000
Graduate Students:			
Number of Students Supported	2	3	6
Amount Graduate Student Support	30,000	50,000	100,000
Other Personnel Costs:			
Amount of Support	3,075,000	4,320,000	3,577,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	10,500,000	—0—
Other Equipment and Instrumentation	—0—	—0—	—0—
Other Direct Research Costs:[1]	17,220,000	10,250,000	22,233,000
Indirect Costs:	300,000	630,000	365,000
TOTAL[2]	$21,000,000	$26,300,000	$27,600,000

[1] Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

[2] Additional ODP funding: Foreign contributions FY 1983—$6,315,260, FY 1984—$1,200,000, FY 1985—$10,000,000
Other U.S. Agencies FY 1983—$ 510,689, FY 1984—$2,000,000, FY 1985—$ 0

Research and Development Special Analysis: Arctic Research Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$6,013,249	$7,147,000	$7,736,000
Applied Research	204,995	244,000	264,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	6,218,244	7,391,000	8,000,000
(Conduct of R&D Performed by Universities and Colleges)	(5,995,823)	(7,136,000)	(7,730,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	6,218,244	7,391,000	8,000,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$6,218,244	$7,391,000	$8,000,000

Quantitative Data Table: Arctic Research Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	117	125	130
Dollars Requested (Total)	$39,602	$20,000,000	$21,000,000
Action Summary			
Number of Awards	68	80	80
Dollars Obligated (Total)	6,218,244	7,391,000	8,000,000
Average Award Size	91,445	92,388	100,000
Average Award Duration (Years)	1.1	1.1	1.1
Dollar Distribution of Funds by Performer			
Universities	5,995,823	7,136,000	7,730,000
Industry	—0—	—0—	—0—
Federal Agencies	64,234	80,000	90,000
Other	158,187	175,000	180,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	93	111	120
Amount of Scientist Support	866,300	1,031,000	1,114,500
Number of Years of Scientist Support	25	30	32
Postdoctoral Support:			
Number of Postdoctorals Supported	10	12	13
Amount Postdoctoral Support	154,600	184,000	199,000
Graduate Students:			
Number of Students Supported	51	61	66
Amount Graduate Student Support	412,700	499,000	531,000
Other Personnel Costs:			
Amount of Support	965,155	1,148,500	1,241,500
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	222,800	265,000	286,000
Other Direct Research Costs:*	2,112,089	2,496,500	2,718,000
Indirect Costs:	1,484,600	1,767,000	1,910,000
TOTAL	$6,218,244	$7,391,000	$8,000,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Scientific, Technological, and International Affairs

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$22,279,411	$23,952,330	$24,980,000
Applied Research	12,102,892	12,420,000	17,395,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	34,382,303	36,372,330	42,375,000
(Conduct of R&D Performed by Universities and Colleges)	(21,114,306)	(22,300,000)	(23,275,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	34,382,303	36,372,330	42,375,000
Education and Training	—0—	—0—	—0—
Other, including Collection of Information	4,465,432	4,450,000	4,525,000
TOTAL	$38,847,735	$40,822,330	$46,900,000

Quantitative Data Table: Scientific, Technological, and International Affairs

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received[1]	2,736	2,757	2,929
Dollars Requested (Total)	$135,319,713	$142,500,000	$146,420,000
Action Summary			
Number of Awards[1]	601	712	736
Dollars Obligated (Total)	38,847,735	40,822,330	46,900,000
Average Award Size	64,638	57,335	63,723
Average Award Duration (Years)	1.2	1.3	1.1
Dollar Distribution of Funds by Performer			
Universities	21,528,430	22,600,000	23,675,000
Industry	8,289,128	10,110,000	15,510,000
Federal Agencies	1,783,383	1,740,000	1,660,000
Other	7,245,794	6,372,330	6,055,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	701	686	782
Amount of Scientist Support	6,888,334	7,069,000	8,137,000
Number of Years of Scientist Support	195	200	225
Postdoctoral Support:			
Number of Postdoctorals Supported	130	137	142
Amount Postdoctoral Support	1,481,015	1,538,000	1,684,000
Graduate Students:			
Number of Students Supported	292	253	257
Amount Graduate Student Support	1,981,347	2,015,000	2,095,000
Other Personnel Costs:			
Amount of Support	3,997,618	4,258,000	5,280,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	1,997,857	2,368,000	2,640,000
Other Direct Research Costs:[2]	12,491,432	12,912,000	14,260,000
Indirect Costs:	10,010,132	10,662,330	12,804,000
TOTAL	$38,847,735	$40,822,330	$46,900,000

[1] The total shown for Proposals Received and Number of Awards includes the Small Business Innovation Research and Industry/University Cooperative Research program elements in order to indicate the coordinating responsibilities of this Activity. Exclusive of these, the number of proposals received for which the Scientific, Technological and International Affairs Activity had primary responsibility are: FY 1983—1,547; FY 1984—1,527; and FY 1985—1,654. The comparable awards are: FY 1983—409; FY 1984—412; FY 1985—416.

[2] Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Industrial Science and Technological Innovation

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$8,937,655	$10,800,000	$11,380,000
Applied Research	5,358,821	6,500,000	11,720,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	14,296,476	17,300,000	23,100,000
(Conduct of R&D Performed by Universities and Colleges)	(8,181,849)	(10,300,000)	(10,700,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	14,296,476	17,300,000	23,100,000
Education and Training	—0—	—0—	—0—
Other, Including Collection of Information	210,349	300,000	300,000
TOTAL	$14,506,825	$17,600,000	$23,400,000

Quantitative Data Table: Industrial Science and Technological Innovation

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received[1]	1,352	1,400	1,450
Dollars Requested (Total)	$61,782,846	$63,500,000	$65,000,000
Action Summary			
Number of Awards[1]	242	355	376
Dollars Obligated (Total)	14,506,825	17,600,000	23,400,000
Average Award Size	59,946	49,577	62,234
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	8,181,849	10,300,000	10,700,000
Industry	6,121,880	7,100,000	12,500,000
Federal Agencies	—0—	—0—	—0—
Other	203,096	200,000	200,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	298	363	445
Amount of Scientist Support	2,030,995	2,464,000	3,232,000
Number of Years of Scientist Support	50	61	75
Postdoctoral Support:			
Number of Postdoctorals Supported	85	103	105
Amount Postdoctoral Support	870,409	1,056,000	1,200,000
Graduate Students:			
Number of Students Supported	127	154	155
Amount Graduate Student Support	1,015,478	1,232,000	1,300,000
Other Personnel Costs:			
Amount of Support	1,160,544	1,408,000	2,340,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	435,205	528,000	800,000
Other Direct Research Costs:[2]	4,511,585	5,452,000	7,030,000
Indirect Costs:	4,482,609	5,460,000	7,498,000
TOTAL	$14,506,825	$17,600,000	$23,400,000

[1] Proposals received and awards supported under the Small Business Innovation Research and the Industry/University Cooperative Research program elements are included here only as an indication of the broad, coordinating responsibilities of this subactivity. The actual number of proposals received, for which Industrial Science and Technological Innovation Subactivity had primary responsibility, was: FY 1983—163; Fy 1984—170; FY 1985—175. The comparable number of awards was: FY 1983—50; FY 1984—55; FY 1985—56.

[2] Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: International Cooperative Scientific Activities

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$3,835,199	$4,700,000	$4,700,000
Applied Research	676,800	800,000	800,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	4,511,999	5,500,000	5,500,000
(Conduct of R&D Performed by Universities and Colleges)	(1,395,275)	(1,650,000)	(1,650,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	4,511,999	5,500,000	5,500,000
Education and Training	—0—	—0—	—0—
Other, including Collection of Information	138,918	—0—	—0—
TOTAL	$4,650,917	$5,500,000	$5,500,000

Quantitative Data Table: International Cooperative Scientific Activities

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	803	800	800
Dollars Requested (Total)	$25,926,294	$25,000,000	$25,000,000
Action Summary			
Number of Awards[1]	86	92	93
Dollars Obligated (Total)	4,650,917	5,500,000	5,500,000
Average Award Size	54,080	59,783	59,140
Average Award Duration (Years)	1.3	1.3	1.3
Dollar Distribution of Funds by Performer			
Universities	1,395,275	1,650,000	1,650,000
Industry	306,960	360,000	360,000
Federal Agencies	176,735	210,000	210,000
Other	2,771,947	3,280,000	3,280,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	15	18	18
Amount of Scientist Support	280,364	330,000	330,000
Number of Years of Scientist Support	9	10	10
Postdoctoral Support:			
Number of Postdoctorals Supported	22	26	26
Amount Postdoctoral Support	287,700	340,000	340,000
Graduate Students:			
Number of Students Supported	1	1	1
Amount Graduate Student Support	500	—0—	—0—
Other Personnel Costs:			
Amount of Support	244,529	290,000	290,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	108,825	140,000	140,000
Other Direct Research Costs:[2]	3,176,898	3,750,000	3,750,000
Indirect Costs:	552,101	650,000	650,000
TOTAL	$4,650,917	$5,500,000	$5,500,000

[1] Actual obligations incurred in International Cooperative Scientific Activities Subactivity were 437 awards for $9,930,591. Three Hundred and fifty-one awards and $5,279,674 were transferred to research activities to facilitate comparison of FY 1983 with FY 1984 and FY 1985.

[2] Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Policy Research and Analysis

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$917,657	$1,000,000	$1,000,000
Applied Research	3,103,869	3,400,000	3,475,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	4,021,526	4,400,000	4,475,000
(Conduct of R&D Performed by Universities and Colleges)	(2,522,710)	(2,450,000)	(2,475,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	4,021,526	4,400,000	4,475,000
Education and Training	—0—	—0—	—0—
Other, including Collection of Information	249,272	200,000	225,000
TOTAL	$4,270,798	$4,600,000	$4,700,000

Quantitative Data Table: Policy Research and Analysis

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	52	85	89
Dollars Requested (Total)	$6,052,189	$5,500,000	$5,620,000
Action Summary			
Number of Awards	93	88	90
Dollars Obligated (Total)	4,270,798	4,600,000	4,700,000
Average Award Size	45,923	52,273	52,222
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	2,522,710	2,450,000	2,475,000
Industry	377,159	950,000	1,000,000
Federal Agencies	104,500	30,000	50,000
Other	1,266,429	1,170,000	1,175,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	96	100	105
Amount of Scientist Support	1,117,933	1,300,000	1,330,000
Number of Years of Scientist Support	25	30	35
Postdoctoral Support:			
Number of Postdoctorals Supported	5	5	8
Amount Postdoctoral Support	41,206	42,000	44,000
Graduate Students:			
Number of Students Supported	56	60	62
Amount Graduate Student Support	317,316	350,000	355,000
Other Personnel Costs:			
Amount of Support	546,690	560,000	580,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	—0—	—0—	—0—
Other Direct Research Costs:*	943,782	998,000	1,015,000
Indirect Costs:	1,303,871	1,350,000	1,376,000
TOTAL	$4,270,798	$4,600,000	$4,700,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Science Resources Studies

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$0	$0	$0
Applied Research	731,390	750,000	800,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	731,390	750,000	800,000
(Conduct of R&D Performed by Universities and Colleges)	(424,936)	(500,000)	(550,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	731,390	750,000	800,000
Education and Training	—0—	—0—	—0—
Other, Including Collection of Information	2,918,991	3,450,000	3,500,000
TOTAL	$3,650,381	$4,200,000	$4,300,000

Quantitative Data Table: Science Resources Studies

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	65	75	80
Dollars Requested (Total)	$8,331,662	$10,000,000	$11,000,000
Action Summary			
Number of Awards	49	54	54
Dollars Obligated (Total)	3,650,381	4,200,000	4,300,000
Average Award Size	74,498	77,778	79,630
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	439,242	500,000	550,000
Industry	1,383,129	1,600,000	1,650,000
Federal Agencies	1,202,148	1,400,000	1,400,000
Other	625,862	700,000	700,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	76	85	87
Amount of Scientist Support	755,106	875,000	935,000
Number of Years of Scientist Support	20	22	23
Postdoctoral Support:			
Number of Postdoctorals Supported	—0—	—0—	—0—
Amount Postdoctoral Support	—0—	—0—	—0—
Graduate Students:			
Number of Students Supported	9	5	5
Amount Graduate Student Support	16,561	33,000	35,000
Other Personnel Costs:			
Amount of Support	752,624	900,000	900,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	—0—	—0—	—0—
Other Direct Research Costs: *	981,453	1,092,000	1,100,000
Indirect Costs:	1,144,637	1,300,000	1,330,000
TOTAL	$3,650,381	$4,200,000	$4,300,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Research Initiation and Improvement

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$8,588,900	$7,452,330	$7,900,000
Applied Research	2,232,012	970,000	600,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	10,820,912	8,422,330	8,500,000
(Conduct of R&D Performed by Universities and Colleges)	(8,589,536)	(7,400,000)	(7,900,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	10,820,912	8,422,330	8,500,000
Education and Training	—0—	—0—	—0—
Other, including Collection of Information	947,902	500,000	500,000
TOTAL	$11,768,814	$8,922,330	$9,000,000

Quantitative Data Table: Research Initiation and Improvement

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	464	397	510
Dollars Requested (Total)	$33,226,722	$38,500,000	$39,800,000
Action Summary			
Number of Awards	131	123	123
Dollars Obligated (Total)	11,768,814	8,922,330	9,000,000
Average Award Size	89,838	72,539	73,171
Average Award Duration (Years)	2.0	2.0	2.0
Dollar Distribution of Funds by Performer			
Universities	8,989,354	7,700,000	8,300,000
Industry	100,000	100,000	—0—
Federal Agencies	300,000	100,000	—0—
Other	2,379,460	1,022,330	700,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	216	120	127
Amount of Scientist Support	2,703,936	2,100,000	2,310,000
Number of Years of Scientist Support	91	77	82
Postdoctoral Support:			
Number of Postdoctorals Supported	18	3	3
Amount Postdoctoral Support	281,700	100,000	100,000
Graduate Students:			
Number of Students Supported	99	33	34
Amount Graduate Student Support	631,492	400,000	405,000
Other Personnel Costs:			
Amount of Support	1,293,231	1,100,000	1,170,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	1,453,827	1,700,000	1,700,000
Other Direct Research Costs: *	2,877,714	1,620,000	1,365,000
Indirect Costs:	2,526,914	1,902,330	1,950,000
TOTAL	$11,768,814	$8,922,330	$9,000,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Program, Development and Management

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$60,996,973	$63,192,350	$66,207,000
Applied Research	4,700,000	3,400,000	4,695,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	65,696,973	66,592,350	70,902,000
(Conduct of R&D Performed by Universities and Colleges)	(0)	(0)	(0)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	65,696,973	66,592,350	70,902,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$65,696,973	$66,592,350	$70,902,000

Quantitative Data Table: Program, Development and Management

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	—0—	—0—	—0—
Dollars Requested (Total)	$0	$0	$0
Action Summary			
Number of Awards	—0—	—0—	—0—
Dollars Obligated (Total)	65,696,973	66,592,350	70,902,000
Average Award Size	65,696,973	66,592,350	70,902,000
Average Award Duration (Years)	—0—	—0—	—0—
Dollar Distribution of Funds by Performer			
Universities	—0—	—0—	—0—
Industry	—0—	—0—	—0—
Federal Agencies	—0—	—0—	—0—
Other	65,696,973	66,592,350	70,902,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	—0—	—0—	—0—
Amount of Scientist Support	—0—	—0—	—0—
Number of Years of Scientist Support	—0—	—0—	—0—
Postdoctoral Support:			
Number of Postdoctorals Supported	—0—	—0—	—0—
Amount Postdoctoral Support	—0—	—0—	—0—
Graduate Students:			
Number of Students Supported	—0—	—0—	—0—
Amount Graduate Student Support	—0—	—0—	—0—
Other Personnel Costs:			
Amount of Support	—0—	—0—	—0—
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	—0—	—0—	—0—
Other Direct Research Costs:*	—0—	—0—	—0—
Indirect Costs:	65,696,973	66,592,350	70,902,000
TOTAL	$65,696,973	$66,592,350	$70,902,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: U.S. Antarctic Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$80,566,120	$93,808,000	$106,921,000
Applied Research	130,165	148,000	159,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	80,696,285	93,956,000	107,080,000
(Conduct of R&D Performed by Universities and Colleges)	(7,963,655)	(10,724,400)	(9,940,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	2,500,000	8,500,000	8,000,000
Total, Support of R&D	83,196,285	102,456,000	115,080,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$83,196,285	$102,456,000	$115,080,000

Quantitative Data Table: U.S. Antarctic Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	260	285	301
Dollars Requested (Total)	$110,588,601	$130,211,600	$143,080,000
Action Summary			
Number of Awards	165	178	183
Dollars Obligated (Total)	83,196,285	102,456,000	115,080,000
Average Award Size	504,220	575,596	628,852
Average Award Duration (Years)	1.2	1.1	1.1
Dollar Distribution of Funds by Performer			
Universities	7,963,655	10,724,400	9,940,000
Industry	12,224,806	19,500,000	21,500,000
Federal Agencies	62,690,524	71,211,600	82,710,000
Other	317,300	1,020,000	930,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	167	190	204
Amount of Scientist Support	1,479,300	1,685,000	1,828,000
Number of Years of Scientist Support	46	52	56
Postdoctoral Support:			
Number of Postdoctorals Supported	18	20	21
Amount Postdoctoral Support	209,000	238,000	256,000
Graduate Students:			
Number of Students Supported	103	117	126
Amount Graduate Student Support	690,100	786,000	844,000
Other Personnel Costs:			
Amount of Support	22,714,500	23,680,600	30,342,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	2,500,000	8,500,000	8,000,000
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	6,151,600	11,728,000	15,974,000
Other Direct Research Costs: *	47,279,257	53,363,900	55,178,000
Indirect Costs:	2,172,528	2,474,500	2,658,000
TOTAL	$83,196,285	$102,456,000	$115,080,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: U.S. Antarctic Research Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$8,866,120	$10,096,400	$10,841,000
Applied Research	130,165	148,000	159,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	8,996,285	10,244,400	11,000,000
(Conduct of R&D Performed by Universities and Colleges)	(7,899,531)	(8,924,400)	(9,840,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	8,996,285	10,244,400	11,000,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$8,996,285	$10,244,400	$11,000,000

Quantitative Data Table: U.S. Antarctic Research Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	251	275	290
Dollars Requested (Total)	$36,388,601	$38,000,000	$39,000,000
Action Summary			
Number of Awards	156	168	172
Dollars Obligated (Total)	8,996,285	10,244,400	11,000,000
Average Award Size	57,668	60,978	63,953
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	7,899,531	8,924,400	9,840,000
Industry	82,868	300,000	100,000
Federal Agencies	697,386	700,000	730,000
Other	316,500	320,000	330,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	167	190	204
Amount of Scientist Support	1,479,300	1,685,000	1,828,000
Number of Years of Scientist Support	46	52	56
Postdoctoral Support:			
Number of Postdoctorals Supported	18	20	21
Amount Postdoctoral Support	209,000	238,000	256,000
Graduate Students:			
Number of Students Supported	103	117	126
Amount Graduate Student Support	690,100	786,000	844,000
Other Personnel Costs:			
Amount of Support	1,914,500	2,180,600	2,342,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	551,600	628,000	674,000
Other Direct Research Costs:*	1,979,257	2,252,300	2,398,000
Indirect Costs:	2,172,528	2,474,500	2,658,000
TOTAL	$8,996,285	$10,244,400	$11,000,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

Research and Development Special Analysis: Operations Support Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$71,700,000	$83,711,600	$96,080,000
Applied Research	—0—	—0—	—0—
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	71,700,000	83,711,600	96,080,000
(Conduct of R&D Performed by Universities and Colleges)	(64,124)	(1,800,000)	(100,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	2,500,000	8,500,000	8,000,000
Total, Support of R&D	74,200,000	92,211,600	104,080,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$74,200,000	$92,211,600	$104,080,000

Quantitative Data Table: Operations Support Program

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	9	10	11
Dollars Requested (Total)	$74,200,000	$92,211,600	$104,080,000
Action Summary			
Number of Awards	9	10	11
Dollars Obligated (Total)	74,200,000	92,211,600	104,080,000
Average Award Size	8,244,444	9,221,160	9,461,818
Average Award Duration (Years)	1.0	1.0	1.0
Dollar Distribution of Funds by Performer			
Universities	64,124	1,800,000	100,000
Industry	12,141,938	19,200,000	21,400,000
Federal Agencies	61,993,138	70,511,600	81,980,000
Other	800	700,000	600,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	—0—	—0—	—0—
Amount of Scientist Support	—0—	—0—	—0—
Number of Years of Scientist Support	—0—	—0—	—0—
Postdoctoral Support:			
Number of Postdoctorals Supported	—0—	—0—	—0—
Amount Postdoctoral Support	—0—	—0—	—0—
Graduate Students:			
Number of Students Supported	—0—	—0—	—0—
Amount Graduate Student Support	—0—	—0—	—0—
Other Personnel Costs:[1]			
Amount of Support	20,800,000	21,500,000	28,000,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	2,500,000	8,500,000	8,000,000
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	5,600,000	11,100,000	15,300,000
Other Direct Research Costs:[2]	45,300,000	51,111,600	52,780,000
Indirect Costs:	—0—	—0—	—0—
TOTAL[3]	$74,200,000	$92,211,600	$104,080,000

[1] Includes contractor, military personnel and military retired pay.

[2] Includes air operations, intercontinental surface transportation, icebreaker operations, station operations, and research ship support.

[3] See next page for additional detail.

Additional detail on use of funds:

U.S. Antarctic Program

Operations Support
($ Millions)

	Actual FY 1983	FY 1984 Current Plan	Estimate FY 1985
Naval Support Force	$47.55	$56.00	$61.00
Military Retirement Costs	—0—	—0—	6.00
Contract Support	12.14	19.20	21.40
U.S. Coast Guard Icebreakers	14.44	14.50	15.00
Research Ship Charter	0.07	1.80*	—0—
Other Cost	—0—	0.70	0.60
Total	$74.20	$92.20	$104.00

*The research ship is chartered only every other year.

Cost Breakout, Naval Support Force

	Actual FY 1983	FY 1984 Current Plan	Estimate FY 1985
Military Personnel	$18.95	$19.75*	$27.30**
Aircraft Operations	12.95	12.85	13.90
Intercontinental Airlift	3.52	3.66	4.00
Intercontinental Sealift	2.51	2.54	3.00
Ground Fuel and Power	3.31	3.30	3.70
Other Costs	6.31	13.90***	15.10***
Total	$47.55	$56.00	$67.00

*Includes $356,000 in FY 1984 supplemental appropriation request for the January 1984 military pay raise.

**Includes $6,000,000 for military retirement costs previously funded by DOD.

***Includes $5,000,000 for LC-130 aircraft Service Life Extension Program.

Research and Development Special Analysis: Science and Engineering Education

	Actual FY 1983	Estimate FY 1984	Estimate FY 1985
Support of R&D			
Conduct of R&D:			
Basic Research	—0—	$5,000,000	$5,000,000
Applied Research	—0—	—0—	—0—
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	—0—	5,000,000	5,000,000
(Conduct of R&D Performed by Universities and Colleges)	—0—	(5,000,000)	(5,000,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	—0—	5,000,000	5,000,000
Education and Training	16,086,570	83,913,430	70,700,000
Collection of Information	—0—	—0—	—0—
TOTAL	$16,086,570	$88,913,430	$75,700,000

Quantitative Program Data: Science and Engineering Education Activity

Proposals and Awards

	Estimate FY 1983	Estimate FY 1984	Estimate FY 1985
Proposals:			
Number of Proposals	4,101	5,600	6,600
Total Amount Proposed	$117,628,500	$502,970,000	$763,500,000
Average Amount Per Proposal	28,613	89,816	115,682
Awards:			
Number of Awards*	1,496	1,843	1,828
Total Amount Awarded	16,086,570	88,913,430	75,700,000
Average Amount Per Award	10,750	48,240	41,410
Average Annual Amount	9,770	37,105	31,850
Average Award Duration (Years)	1.1	1.3	1.3

Dollar Distribution of Funds Awarded by Performer

	Actual FY 1983	Estimate FY 1984	Estimate FY 1985
Universities & Colleges	14,396,667	79,421,833	71,050,000
Other Nonprofit Organizations	1,689,903	8,491,597	3,950,000
Industry	—0—	1,000,000	700,000
Other	—0—	—0—	—0—

Personnel and Other Award Factors

Professional Staff Costs	$655,135	$28,952,490	$23,189,320
Other Staff Costs	414,450	5,679,360	4,560,970
Subtotal, Staff Costs	1,069,585	34,631,850	27,750,290
Expendable Supplies & Equipment	96,445	2,189,840	1,694,833
Permanent Equipment	—0—	3,400,000	2,700,000
Other Project Direct Costs	263,248	3,465,587	4,478,101
Subtotal, Nonstaff Project Costs	359,693	9,055,427	8,872,934
Total, Direct Costs	1,429,278	43,687,277	36,623,224
Indirect Costs	560,625	17,504,320	14,026,776
Participant Support Costs:			
Stipend & Other Personal Allowances	8,923,578	20,401,300	17,982,010
Cost-of-Education Allowances	5,173,089	7,320,533	7,067,990
Total, Participant Support Costs	14,096,667	27,721,833	25,050,000
Grand Total	$16,086,570	$88,913,430	$75,700,000

* Includeds Fellowships (1390 in FY 1983, 1510 in FY 1984, 1550 in FY 1985).

Research and Development Special Analysis: Graduate Research Fellowships

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	—0—	—0—	—0—
Applied Research	—0—	—0—	—0—
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	—0—	—0—	—0—
(Conduct of R&D Performed by Universities and Colleges)	—0—	—0—	—0—
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	—0—	—0—	—0—
Education and Training	14,978,167	20,321,833	21,000,000
Collection of Information	—0—	—0—	—0—
TOTAL	$14,978,167	$20,321,833	$21,000,000

Quantitative Program Data: Graduate Research Fellowships Subactivity

Proposals and Awards

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposals:			
Number of Proposals	3,830	4,000	4,500
Total Amount Proposed	$42,628,500	$52,970,000	$63,500,000
Average Amount Per Proposal	11,130	13,225	14,111
Awards:			
Number of Awards*	1,390	1,510	1,550
Total Amount Awarded	14,978,167	20,321,833	21,000,000
Average Amount Per Award	10,776	13,458	13,548
Average Annual Amount	10,776	13,458	13,548
Average Award Duration (Years)	1.0	1.0	1.0
Total Number of Participants Supported	1,390	1,510	1,550

Dollar Distribution of Funds Awarded by Performer

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Universities & Colleges	14,096,667	19,421,833	20,050,000
Other Nonprofit Organizations	881,500	900,000	950,000
Industry	—0—	—0—	—0—
Other	—0—	—0—	—0—

Personnel and Other Award Factors

Professional Staff Costs	$155,135	$152,490	$189,320
Other Staff Costs	264,450	179,360	160,970
Subtotal, Staff Costs	419,585	331,850	350,290
Expendable Supplies & Equipment	26,445	89,840	94,833
Permanent Equipment	—0—	—0—	—0—
Other Project Direct Costs	164,845	73,990	78,101
Subtotal, Nonstaff Project Costs	191,290	163,830	172,934
Total, Direct Costs	610,875	495,680	523,224
Indirect Costs	270,625	404,320	426,776
Participant Support Costs:			
Stipend & Other Personal Allowances	8,923,578	12,101,300	12,982,010
Cost-of-Education Allowances	5,173,089	7,320,533	7,067,990
Total, Participant Support Costs	14,096,667	19,421,833	20,050,000
Grand Total	$14,978,167	$20,321,833	$21,000,000

* 1,390 awards funded from FY 1983 appropriations, 65 additional awards funded from prior year balances available to educational institutions

Research and Development Special Analysis: Pre-College Science and Mathematics Education

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	—0—	$5,000,000	$5,000,000
Applied Research	—0—	—0—	—0—
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	—0—	5,000,000	5,000,000
(Conduct of R&D Performed by Universities and Colleges)	—0—	(5,000,000)	(5,000,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	—0—	5,000,000	5,000,000
Education and Training	1,108,403	63,591,597	49,700,000
Collection of Information	—0—	—0—	—0—
TOTAL	$1,108,403	$68,591,597	$54,700,000

Quantitative Program Data: Precollege Science and Mathematics Education

Proposals and Awards

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposals:			
Number of Proposals	281	1,600	2,100
Total Amount Proposed	$75,000,000	$450,000,000	$700,000,000
Average Amount Per Proposal	266,904	281,250	333,330
Awards:			
Number of Awards	106	333	278
Total Amount Awarded	$1,108,403	$68,591,597	$54,700,000
Average Amount Per Award	10,457	205,981	196,762
Average Annual Amount	5,228	68,660	65,587
Average Award Duration (Years)	2.0	3.0	3.0

Dollar Distribution of Funds Awarded by Performer

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Universities & Colleges	$300,000	$60,000,000	$51,000,000
Other Nonprofit Organizations	808,403	7,591,597	3,000,000
Industry	—0—	1,000,000	700,000
Other	—0—	—0—	—0—

Personnel and Other Award Factors

Professional Staff Costs	$500,000	$28,800,000	$23,000,000
Other Staff Costs	150,000	5,500,000	4,400,000
Subtotal, Staff Costs	650,000	34,300,000	27,400,000
Expendable Supplies & Equipment	70,000	2,100,000	1,600,000
Permanent Equipment	—0—	3,400,000	2,700,000
Other Project Direct Costs	98,403	3,391,597	4,400,000
Subtotal, Nonstaff Project Costs	168,403	8,891,597	8,700,000
Total, Direct Costs	818,403	43,191,597	36,100,000
Indirect Costs	290,000	17,100,000	13,600,000
Participant Support Costs:			
Stipend & Other Personal Allowances	—0—	8,300,000	5,000,000
Cost-of-Education Allowances	—0—	—0—	—0—
Total, Participant Support Costs	—0—	8,300,000	5,000,000
Grand Total	$1,108,403	$68,591,597	$54,700,000

Research and Development Special Analysis: Special Foreign Currency

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Support of R&D			
Conduct of R&D:			
Basic Research	$2,212,871	$2,090,000	$2,010,000
Applied Research	872,104	823,680	790,000
Development	—0—	—0—	—0—
Subtotal, Conduct of R&D	3,084,975	2,913,680	2,800,000
(Conduct of R&D Performed by Universities and Colleges)	(679,948)	(640,000)	(620,000)
R&D Facilities:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Total, Support of R&D	3,084,975	2,913,680	2,800,000
Education and Training	—0—	—0—	—0—
Collection of Information	—0—	—0—	—0—
TOTAL	$3,084,975	$2,913,680	$2,800,000

Quantitative Data Table: Special Foreign Currency

	Actual FY 1983	*Estimate FY 1984*	*Estimate FY 1985*
Proposal Summary			
Number of Proposals Received	217	220	220
Dollars Requested (Total)	$7,397,705	$7,400,000	$7,400,000
Action Summary			
Number of Awards	122	115	110
Dollars Obligated (Total)	3,084,975	2,913,680	2,800,000
Average Award Size	25,287	25,336	25,455
Average Award Duration (Years)	1.1	1.2	1.2
Dollar Distribution of Funds by Performer			
Universities	679,948	640,000	620,000
Industry	—0—	—0—	—0—
Federal Agencies	175,606	170,000	160,000
Other	2,229,421	2,103,680	2,020,000
Personnel			
Senior Scientists:			
Number of Scientists Supported	149	141	135
Amount of Scientist Support	2,213,970	2,090,000	2,000,000
Number of Years of Scientist Support	43	40	39
Postdoctoral Support:			
Number of Postdoctorals Supported	—0—	—0—	—0—
Amount Postdoctoral Support	—0—	—0—	—0—
Graduate Students:			
Number of Students Supported	33	30	30
Amount Graduate Student Support	140,398	130,000	130,000
Other Personnel Costs:			
Amount of Support	172,798	160,000	160,000
R&D Facilities, Equipment, and Instrumentation:			
Land, Buildings and Fixed Equipment	—0—	—0—	—0—
Major Equipment	—0—	—0—	—0—
Other Equipment and Instrumentation	—0—	—0—	—0—
Other Direct Research Costs: *	557,809	533,680	510,000
Indirect Costs:	—0—	—0—	—0—
TOTAL	$3,084,975	$2,913,680	$2,800,000

* Includes: Supplies, Publications, Consultants, Computer Subcontracts, Travel.

NUMBER OF GRANTS VERSUS NUMBER OF SCIENTISTS SUPPORTED

Dr. KNAPP. I would like to make a comment about the whole dialog we have had on the number of grants and the problems that the National Science Foundation faces in planning its programs for the future.

I think we are caught in a problem here associated with the way science is funded, the way science is performed in universities, the kind of equipment that we have to buy these days for scientific investigation, and also the number of senior investigators and the number of grants.

I would say the number of senior investigators suppported is a better measure than the number of grants that we produce. Science is moving toward a requirement that we share equipment, that we share instrumentation, and that we utilize on a team basis some of the tools of our trade, so to speak. The expense of some of these tools is getting beyond the capability of individual grants to provide.

So, for example, in our engineering centers proposal for this year, we are proposing that, rather than having 20 individual grants, we have instead 1 grant to a university, which then has 20 very senior investigators working on this grant, sharing instruments, sharing equipment, sharing ideas, and allowing their research to become interdisciplinary and more directly linked to industrial practice in engineering. This is also true in materials science, true in high-energy physics, and true in many other fields of science.

I believe that because of these pressures, the correct figure of merit is the number of senior faculty we support in doing research. We feel that, in many areas of science, it is essential that we conglomerate, so to speak, our support so that we get more efficient use of the funds that we provide.

Senator GARN. I understand what you are saying. You know our dialog has been on the basis of what I have been trying to accomplish. I certainly don't say that just the number of grants is a correct or proper measure of whether we are being efficient or not. But our discussions in previous hearings have simply been on the basis that it has been my feeling that often there are discoveries made on research projects by those that are not the senior people. There are many, many examples. I am not going to go back into all of that. And some of the ones that didn't look quite as promising turned out to be rather successful and produced a great deal for this country. So that is what I am aiming at when I say try to spread out not just the number of grants, but create the opportunity for some of the research that otherwise would not take place and in times past has proven very, very fruitful.

Dr. KNAPP. I am completely in agreement with that sentiment. I think we have to support the maximum number of people that we possibly can with the funds we have and in the most efficient way. We will be working with your staff to try to ascertain a figure of merit which will give you an idea of the efficiency with which we are getting funds into the entire scientific community for people who might be overlooked but yet might have excellent ideas.

Dr. Good, would you like to comment?

Dr. GOOD. Yes, I would, if I may.

With respect to the whole concept of the centers in the engineering area and the centers that have gone on now for a number of years in the materials science area, I absolutely agree, Senator, with your intent. I think it is an extraordinarily important issue.

Dr. Knapp, in his full testimony, discusses some of those issues. If you look at the amount of return in terms of people and research that you get for the dollars spent, you find that it is best in areas, such as the materials centers, where you provide a core of instrumentation and some core grants. What that does is let some of the people you have just described conduct their research. The equipment is there, so if the university can put up something, even though these researchers may have missed getting a grant, they still have access to what is required to conduct their research. They can get it off the ground and get the attention it deserves to then get it funded.

Those things turn out to be very synergistic. If you look at them, the NSF funding in many cases has been the leverage which those people have then used to go to DOE, DOD, all kinds of other places to further leverage that money. In some way, we have to be able to have a measure which tells one how that happens so one has an understanding of it.

That is beginning to happen in other disciplines. For example, chemistry, at one time, was referred to around the country as a cottage industry. In other words, every chemist had his or her own separate individual grant. They are beginning to come around as well because of the equipment that they need today. It just isn't feasible to fund an individual with all of that gear. What we need to do is to look at those issues, and the Board has made some efforts in those directions. We intend to do more.

We are in sympathy with the way you want to go. The question is, how do we measure it accurately and how do we report it.

PERCENT OF PROPOSALS FUNDED

Senator GARN. According to your budget justification, the Foundation funded approximately 38 percent of the proposals submitted during fiscal year 1983. In fiscal year 1984 you expect to fund 36 percent of the submitted proposals, and in fiscal year 1985, 33 percent. This is the second budget justification that exhibits a declining percentage of awards.

Last year when I asked you if this reflected a decision on the part of the Foundation to fund a smaller percentage of the proposals over time, you said it did not. Where it isn't a conscious decision—and I accept that—of the Foundation, how do you explain that trend of the downward percentage of awarding of grants?

Dr. KNAPP. Is this for the entire Foundation, the statistics, or is this for the science education part?

Senator GARN. Research.

Dr. GOOD. I think that is the research budget.

Dr. KNAPP. There is not a conscious policy on the part of the Foundation to fund a smaller percentage of grants.

Senator GARN. I accept that. That is what you said last year. I don't dispute that. I don't think it is. I am just trying to determine why, why the trend is continually downward. I accept the fact it is not a conscious decision. I wonder if you know why.

Dr. KNAPP. I would like to ask the Controller if he would like to comment on that.

This is Dr. Hayes, Controller of the Foundation.

Dr. HAYES. Maybe if I could just offer what I think is a partial explanation.

One of the things that happens during a period when budgets are going up is that the scientific community and even individual scientists write more proposals than they would otherwise. I think one of the things that you are seeing in these numbers is the anticipation that the Foundation will receive additional proposals just because the numbers are going up at a more rapid rate than they were previously.

In addition, of course, we have a number of new activities in the budget, such as the engineering centers, which are likely to draw a lot of special attention and proposals which will drive the number of proposals up. But in that particular instance the number of awards is expected to be rather small. So it wouldn't be surprising, for instance, in that particular area, if we saw 70 to 100 proposals.

We had a similar experience with the regional instrumentation facilities program earlier. When the program was announced, although there were only 5 initial awards, I believe there were over 100 proposals that came in for these awards. When you start new activities and funding is going up, you often see an increase in proposals until you get into a more stable situation.

Senator GARN. But you are also buying more equipment, aren't you?

Dr. HAYES. Yes. The percentage of the total that is going into equipment is increasing somewhat.

Another point should be considered in terms of driving up the grant sizes for those people that we do support. In addition to equipment, there is the necessity to provide adequate support for maintenance and supplies so that the equipment that we put in place—and we have made a substantial increase in the amount of equipment that our grantees have—can be used effectively in pursuing experimental research in particular.

Dr. GOOD. Senator, I would like to make another observation on a matter that I think is having an impact. The Board, in its June meeting this year, is going to try to look at university infrastructure and examine what is actually going on at universities today. I think one of the things we are going to find and one of the reasons for looking at universities, particularly the State universities, is that it is becoming more and more difficult for them to fund out-of State-moneys and out of their own moneys the kinds of beginning research that they used to do. It used to be that both private universities and State universities had starter grants. They had money from their own hands that they could use to start people to do those kinds of things. If you talk to universities today, I think their potential for doing that is significantly less than it used to be. When that happens, the pressure to get more research grants from outside gets heavier.

I think this is one of the reasons for the increase in the number of proposals we are seeing. I don't think that is going to slacken, Senator. I think that is another reason why the increase in the NSF budget is so very important.

Dr. KNAPP. Senator, I would like to say that we will try to analyze this problem for the record and provide a detailed explanation of the decrease in the percentage of success for our grants.

I think, as we have indicated, that it is perhaps new programs which we are starting, such as the Presidential young investigators program, which had 200 awards but had almost 2,000 applicants, that may be driving some of this change. But we can look at our records, and we can provide a detailed breakdown and try to understand the success rate in the standard research and related activities of the Foundation, if we are, in fact, seeing this decrease in success.

[The information follows:]

PROPOSAL AND AWARD TRENDS, FY 1983-FY 1985

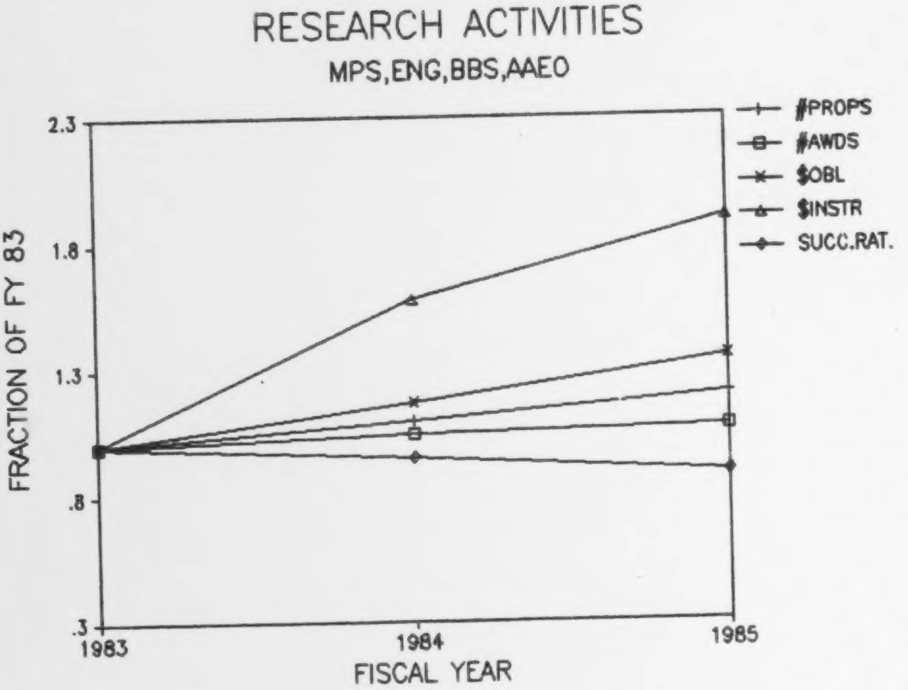
Expected trends for number of proposals, number of awards, total funds obligated, instrumentation support, and success ratio for the period FY 1983-FY 1985 are displayed in the accompanying figures. Amounts for FY 1984 and FY 1985 have been normalized to FY 1983 for display purposes.

For MPS, ENG, BBS, and AAEO as a group, relative to total funds obligated:

- The number of awards and the number of proposals increases less rapidly than the funds obligated;
- Funding for instrumentation increases much more rapidly; and
- There is a slight decrease in the overall success ratio.

Clearly, part of the increase in the NSF budget is going toward more awards, while a significant fraction is being used to provide adequate funding for research instrumentation. These two factors lead to an increase in average award size. The latter, taken together with increased proposal pressure, tends to depress the success ratio. An increase in proposals received correlates with, but lags behind, obligations.

Similar behavior is exhibited by ENG, BBS, and AAEO. For MPS, however, the anticipated success ratio rises by about 2% over the three-year period. BBS displays the NSF-wide pattern somewhat more dramatically. For this activity, proposal pressure is anticipated to rise at the same rate as total obligations, or by about 30% over FY 1983 - FY 1985. Since the number of awards will increase by about 4%, the success ratio will drop from about .37 to .29. Such behavior is significant because, as shown in the figures, BBS receives a major share of NSF proposals.


RESEARCH ACTIVITIES
MPS,ENG,BBS,AAEO
#PROPS
#AWDS
$OBL
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FRACTION OF FY 83
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1.8
1.3
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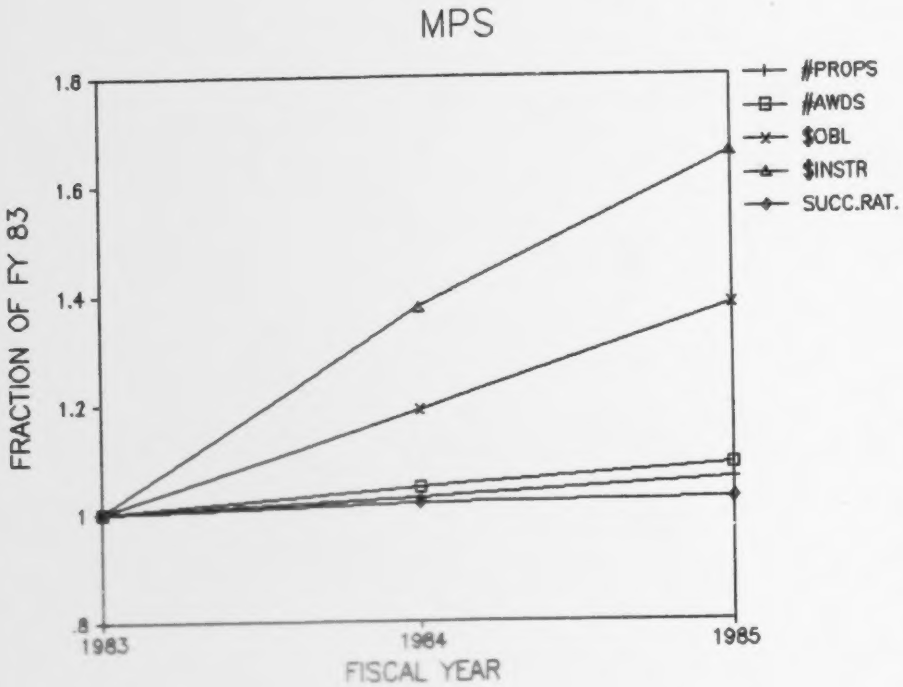
1983
1984
1985
FISCAL YEAR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#PROPS
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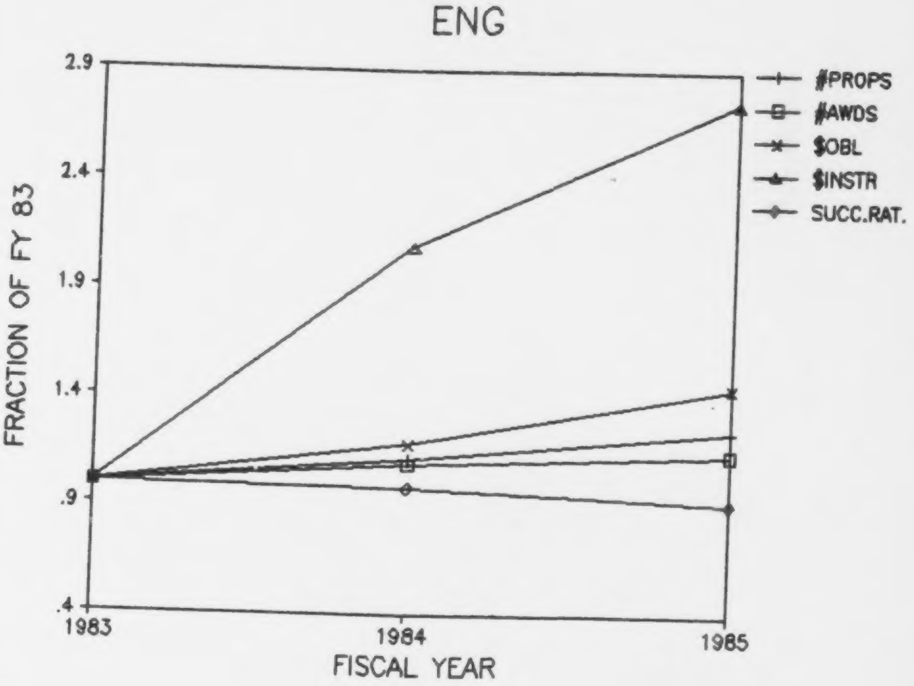
ENG
2.9
2.4
1.9
1.4
.9
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FRACTION OF FY 83
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FISCAL YEAR
#PROPS
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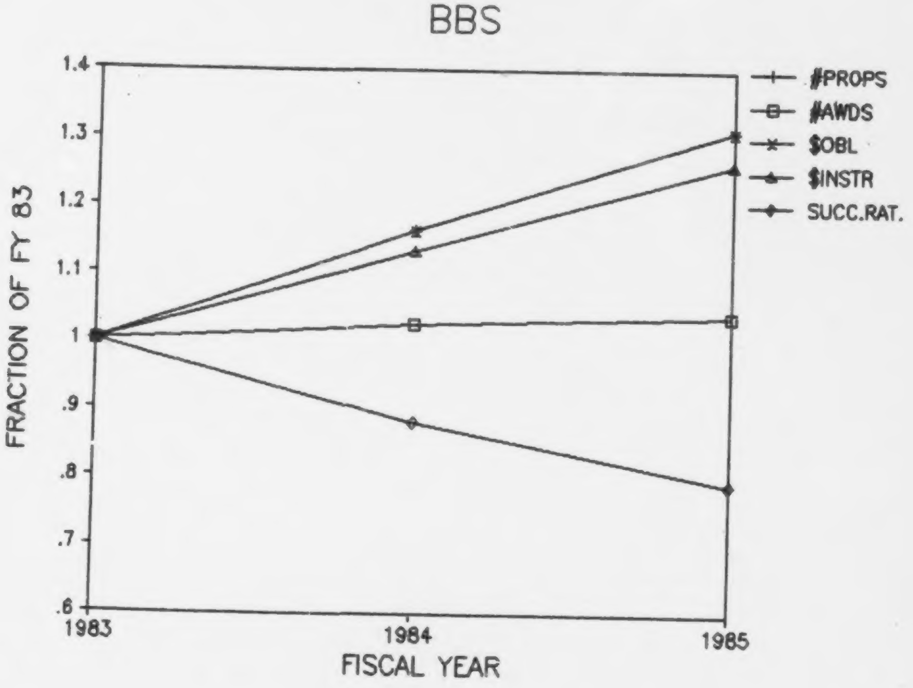
BBS
1.4
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1.2
1.1
1
.9
.8
.7
.6
FRACTION OF FY 83
1983
1984
1985
FISCAL YEAR
#PROPS
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$OBL
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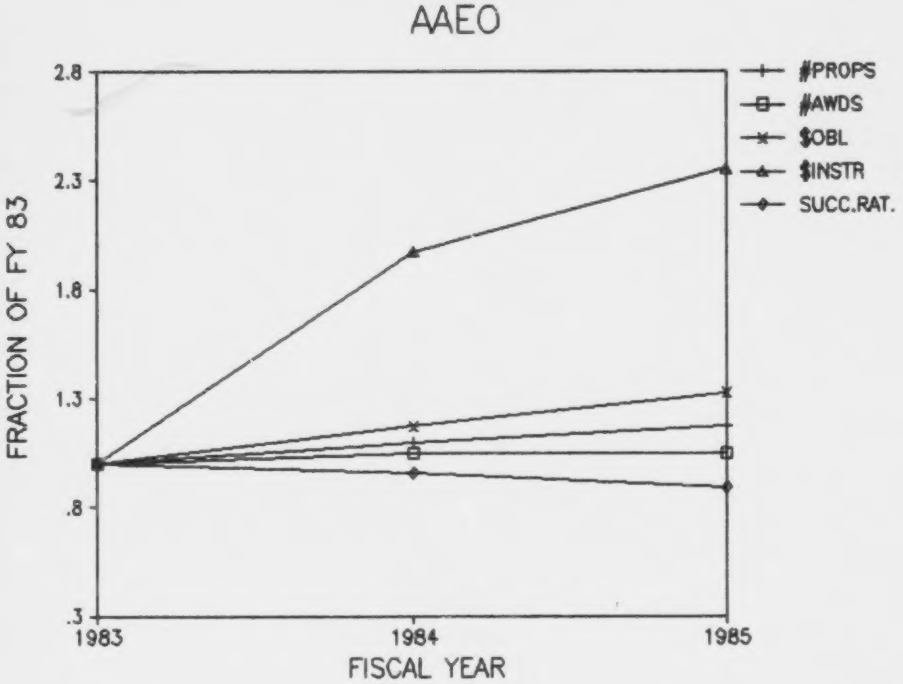
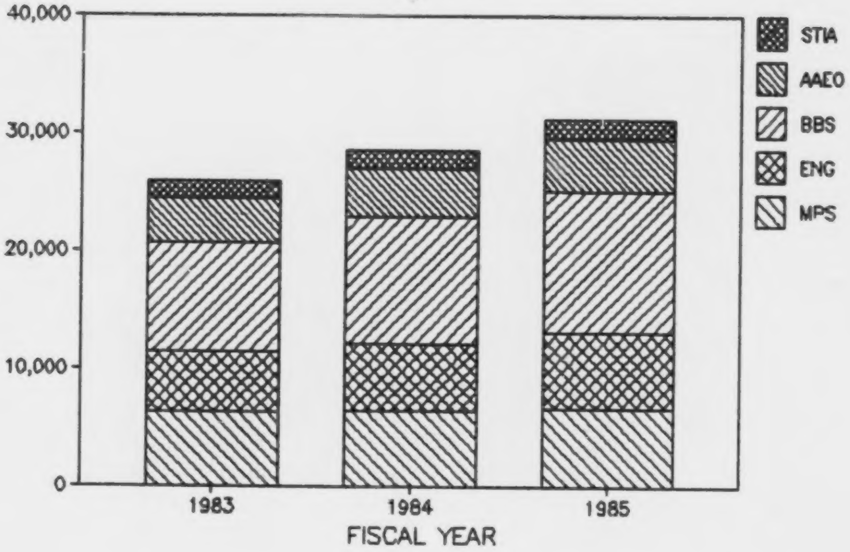
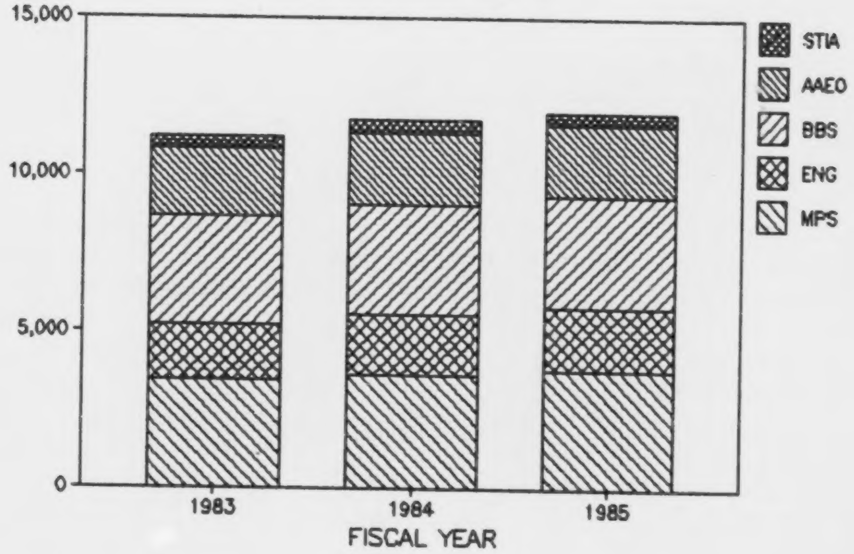
SUCC.RAT.


AAEO
FRACTION OF FY 83
2.8
2.3
1.8
1.3
.8
.3
1983
1984
1985
FISCAL YEAR
#PROPS
#AWDS
$OBL
$INSTR
SUCC.RAT.

No. of Proposals
(Cumulative Totals)



No. of Awards
(Cumulative Totals)



PERCENTAGE INCREASE IN THE NUMBER OF AWARDS

Senator GARN. At the hearings last year, I asked you if a 1-percent increase in the number of awards was an appropriate plan for the Foundation during the next several years. You stated that you didn't think we could make science really healthy in the country with an increase of only 1 percent or so. Have you changed your mind?

Dr. KNAPP. Again, we are getting into the problem of awards or people support. We need to support more than 1 percent more people. We need to make our science healthy, and we need to, as I explained in the answer to the previous question, consolidate or perhaps make fewer awards. But we need to bring more people in the universities into the scientific research system, and that, I think, is more than a 1-percent change.

We need to accommodate as many people doing high-quality research as we can with the funds we have.

Senator GARN. The reason I ask is because the number of grants is expected to increase only by seven-tenths of 1 percent. That is why I related you back to your quote of last year, that we needed more than 1 percent. Yet we are looking at about seven-tenths of 1 percent. While your research support is up 14.4 percent, your number of scientists supported is only up 3.4 percent, so only a 5.7-percent increase in the area of scientist support. So I think we need to monitor those numbers.

Dr. KNAPP. I would hope, at this time, with the 1985 budget, that we have a more stable situation with respect to equipment funding. And when that very serious problem with the balance of funds within our grants is corrected, I think we will see the additional funds for research that we are asking for go more to increasing the number of people involved in the process and less to trying to repair past imbalances.

Senator GARN. I just wanted you to know I agree with your quote of last year, that 1 percent wasn't enough. [Laughter.]

SCIENCE EDUCATION PLAN

Since January 1983 the subcommittee has been actively involved in trying to assist the Foundation in defining what needs to be done to improve science education and how this can best be accomplished. As a result of the importance of science education and our interest in it, we have spent more time on this issue than any other single NSF program. And I can say with all candor that sometimes I question whether the results to date really have justified the effort that has been put into it.

I don't have to tell you the central role that science education will play over the next decade in this Nation's economic and national security future. NSF alone will have responsibility for around $75 million annually in science education. We can spend this money, as we have in the past, or we can invest it in the Nation's future. The difference between the past approach and the one needed for the future is, in my mind, a matter of developing specific program objectives and a strategy to manage the program and measure its success against these objectives.

On February 3, I sent you a letter expressing some of my concerns. In particular I stated, and I quote:

> I see no evidence that the Directorate has developed a management plan for science education. The assumption that a budget allocation and a plan are synonymous is obviously false. As our staffs have discussed, I believe that the Directorate must develop specific goals and objectives for the various components of the science education program. Such goals must be accompanied by a set of explicit documents identifying the various steps in the life of a project from problem identification through delivery to the ultimate user.

Since this type of management structure departs from the traditional way that programs have been managed at the Foundation, I also suggested in the letter that NSF contract with an organization that has the management experience and skills to develop the necessary management tools.

Are you considering this approach to developing a plan for science education and what is your timeframe for making a decision on this contract?

Dr. KNAPP. We have received your letter, Senator. We are looking very carefully at a management and organizational plan which will accomplish the goals which you and we share of a program focused on specific objectives within science education. At the same time, we intend to accomplish these goals by utilizing the strengths of the Foundation and the parts of the Foundation and its methods of operating which have served it so well in the past.

We understand the problems of program management. We understand that science education is a very different field of endeavor than scientific research, that it needs a different management style. But our major strengths are our connections with the universities and colleges around this country and our method of peer review. Any system which we have has to be able to take unsolicited proposals. It has to be able to manage those proposals and develop the best ideas through to the end product, which is use of the materials developed in our programs, in the widest number and with the broadest possible distribution.

Mr. Berger of your staff has shown us this example of a program management structure which you just gave me. I agree that those steps are some of the steps which are necessary in order to manage a program. I would like to provide for you a major event flow chart from a past program within the Foundation which indicates some of the steps in the flow of decisions that had to be made and the kinds of decisions that had to be made in a very successful program in science education which was funded and carried through from the germination of an idea to application in the classroom in the past.

You will notice that that program took many years to accomplish, and it was very successful. This flow chart was put together by SRI, an outside firm, and it was to explain why this was successful and others, perhaps, were not.

We have no active plans at the present time to contract a management consulting firm to help us within the Foundation. We feel that we will be able to come up with a program of management which you will find very satisfactory. We will be discussing that with you, as you requested in your letter, at the end of this month.

IDENTIFICATION OF ISSUES IN SCIENCE EDUCATION

Senator GARN. If I could explore that just a little bit further. You do have an example of a program management structure submitted by the staff of the subcommittee before you. I think it might be worthwhile just to spend a few minutes going over some of the management functions that are suggested in that chart.

First, can you tell me what the Foundation is doing to identify and define the general issues that need to be addressed in science education, who is involved in that process, and when we will have such a list of issues?

Dr. KNAPP. The problem identification will be done by the staff of the Foundation and the Advisory Committee to the Assistant Directorate for Science and Engineering Education. We are in the process of chartering that advisory group. The proper notification has been published, or will be published very shortly, in the Federal Register, which is required. We have a list of candidates for membership on the advisory committee and we will have a first meeting of that committee fairly soon.

Perhaps Dr. Bautz would like to comment on that particular committee and other questions as they come forward. Dr. Bautz is the Acting Assistant Director for Science and Engineering Education.

Dr. BAUTZ. The charter for the Advisory Committee for Science and Engineering Education has been through the process that is required in order for us to begin holding meetings. We have, in the last few weeks or months, solicited nominations for the members of this committee. We have something on the order of 120 nominations that have been made to us, both from the staff of the Foundation and from several external professional groups we contacted and invited to submit nominations. By the end of next week we plan to have selected 20 people to be the first members of the newly constituted advisory committee.

On the broader issue of identifying goals and objectives for science and engineering education, we feel this is a very complicated and involved process and we start with a goal that was enunciated by the National Science Board Commission on Precollege Education, which says we would like to provide high-quality mathematics and science education at the precollege level for all students, as opposed to our past concentration on simply those who were planning on going into careers in science and math and engineering.

We feel that this process of identifying what is needed must involve the communities that are involved with preparing the materials and identifying what science and math people should have a command of in order to live well in the society.

We are involving several of the professional societies, such as the American Physical Society, the American Chemical Society, the Conference Board of the Mathematical Sciences, and so on. Several of these groups—and we expect others to do so soon—have come forward with proposals to study their own areas and identify what is needed. We feel that this is an appropriate way to gain an understanding of the entire framework of what already exists and should be continued in the future.

Senator GARN. Why don't you just sit at the table. I think maybe some of these next questions will probably end up with you.

Next, can you tell me when we will identify potential ways of addressing these issues, specify which approaches are appropriate for NSF to pursue, assess the probable success of each of these approaches, and, finally, who will be involved in these determinations?

Dr. KNAPP. Dr. Bautz?

Dr. BAUTZ. I am not sure I got the entire question.

Senator GARN. Do you have a hot potato you are passing back and forth? [Laughter.]

Dr. BAUTZ. Pardon me?

Senator GARN. Excuse me. Go ahead. Talking about the items on the chart.

Dr. BAUTZ. As I already indicated, in the area of problem identification, which is the first line here on the chart——

Senator GARN. Don't worry about the buzzer. It just indicates the country is now in danger, the Senate is in session. [Laughter.]

Dr. BAUTZ. As far as problem identification is concerned, we envision that it will be a combination of our own advisory group, the formally constituted one, advice we get in the course of peer review of individual proposals, and results of various studies that are being conducted under grants that have been made and that might be made in response to future proposals. We also have continuous discussions going on with members of the various communities that guide the staff and develop staff ideas. We also get advice from the National Science Board.

We have virtually a continuous stream of advice from various sources.

Problem definition is essentially part of the problem of identification and understanding what is needed. I think we will get advice from all of the sources that I mentioned.

PROBABILITY OF SUCCESS OF A PROJECT

Senator GARN. What about probability of success? What is your assessment?

Dr. BAUTZ. In assessing the probability of success on any given project that is proposed to us, we rely on peer review and a peer review system which includes the broader definition of peers that is appropriate for science education. These peers include teachers, school board people, and materials development experts, in addition to the people in the scientific community that provide us information on the scientific quality of the proposed materials.

Senator GARN. What about the probability of success in the implementation of the program afterward, the end product?

Dr. Bautz. I think that, as people propose projects and get experience with projects, we have the situation where each project, while it may follow a certain general, overall pattern, is different in its details. As we move through a given project, we will have to monitor it closely and seek advice from outside experts when it becomes necessary to guide the people who are developing things so that they will get used.

Dr. Knapp. Might I make a comment here?

Senator Garn. Sure.

Dr. Knapp. I think that we are trying to define a proposal, in the sense we are talking about now, slightly differently than we had in the past. We are insisting that we see in the proposals a way through to the other end at the time that the initial proposal comes in. We would expect to see proposals, for example, involving materials from textbook manufacturers, together with universities or teachers. The initial proposal should show ~~us~~ how this work in going from the design of some materials, through to a publisher, who will produce the material for use. It should also illustrate how it will then get disseminated through the support of various professional societies. This is perhaps slightly different than we did it in the past.

But I should emphasize that we expect proposers to discuss ways to achieve the results of their research, rather than just have a package of research accomplished which then can sit and never be used.

Maybe Dr. Bautz could comment on that.

Dr. Bautz. I would like to take this opportunity to say something about the way I envision the organization of the precollege work at the NSF, and I have discussed this with Dr. Berger on prior occasions. I would like to have an emphasis on the subject matter and have our program staff think of themselves as identified with handling proposals in a given discipline.

I wanted to do this because I believe that the entire system that is needed, from conception of an idea through development of materials and the necessary testing and training of teachers and so on, will be done within the scientific community that is involved. By having our staff have this particular orientation toward subject matter, I believe the interactions with the community on the outside that are necessary to actually have the work done will be facilitated.

IDENTIFICATION OF FEDERAL, LOCAL, AND NONGOVERNMENTAL PARTNERS

Senator Garn. When will a mechanism be established that can be used to identify the various Federal, local, and nongovernment partners that are responsible for various components of a project, and what procedures do you intend to implement to formalize these responsibilities?

Dr. Bautz. In the course of preparing our response to your letter of February 3, we are analyzing for, say, a generic project, if you will, the various roles and various players. I think that, rather than to try to formalize a particular model and require that all projects follow the same model, we should encourage people to do what is appropriate in individual cases.

In our response we could identify for you what the various roles are that we would see for a general project. I don't know what further formalization one might wish to establish.

Senator GARN. How do you intend to incorporate the specific timetables, expected projects and specific interfaces required for a successful project into your solicitations and peer review process?

Dr. BAUTZ. Again, in our guidelines for preparation of proposals in the precollege area, we specify that a criterion for evaluation is the appropriateness of the plan that is put forward in a proposal and that it should be workable and show an awareness of the problems the project is likely to encounter.

I am sorry, what was the rest of your question?

Senator GARN. Well, let me just follow on with an additional question. When will you, for example, be ready to announce the availability of funds for the development of the specific course or for a particular target audience using a designated presentation technique or media?

Dr. BAUTZ. I would envision that our ability to identify the need for such a specific thing as you described will depend on the progress which the fields make in advising us of what is needed. I also anticipate that, as the fields identify what they regard as the necessary new materials to be developed, this information will be available to the community and that people will frequently come forward spontaneously to propose those things to us. In the event that doesn't happen, I think, once we are aware of the need and allow a reasonable time for spontaneous submission of a proposal, we would be prepared to go out with a solicitation for such.

PROJECT REVIEW AND POSTPERFORMANCE ASSESSMENT

Senator GARN. What plans have you made to incorporate a midterm review and a postperformance assessment for each project?

Dr. BAUTZ. We have progress reports and so on for the various projects that we support. These are reviewed by the staff. In the case of large or complicated projects, we have the mechanism of taking a team of outside consultants to review the project, either before it starts or at stages during the project.

An example of this is a recent site visit to a major project in informal science education which would be coming out soon. We flag such projects as the grants are initially made, those which we expect will require additional or closer supervision than a routine project.

Senator GARN. I recognize I put you on the spot, and I have done it deliberately. I also want you to know I expect all definitive answers to these questions I ask you today. Part of the reason for it is simply to make you aware of my continuing interest, that we do develop a management technique in this area. I am not a scientist. I don't pretend to be and I would not convince anybody that I was if I tried to. But I have had some experience in management and business in other areas. As much respect as I have for the National Science Foundation and as difficult as this issue is to get a handle on, the potential impact that it has on the country is great. Therefore, I think it is worth the effort to develop the type of things we are talking about. Call it bang for the buck or whatever. That is what we are trying to do in this subcommittee, working with you, sending out an example of the program management structure and so on. There is no great pride of authorship in there; just a desire to continue this dialog and see if we can get something done to drive you in that direction because the outcome of all of this is so important. So I hope we can continue to work with you on it.

I would like you to submit in writing your proposed program management plan for science education to the subcommittee by April 2.

Dr. KNAPP. We will do that. We are planning to do that. It is in the active stages of preparation. I would just like to reiterate the comment that I made at the beginning of this particular branch of our discussion. That is that the Foundation has a particular history. It has a particular staff. The staff has particular talents. And our clientele has particular ways of working and doing things.

Our goals are identical with yours and your subcommittee's goals. We want to spend the taxpayers' money in the most efficient and appropriate way that we possibly can. We feel that the plan that we are developing will be responsive to your needs in the context of what we have to work with and how we can go about doing our business.

EFFECT OF COLLATERAL ISSUES ON SCIENCE AND MATHEMATICS EDUCATION

Senator GARN. Last week the staff attended a symposium on science education in the U.S. Capitol. At that time the speaker, a prominent educator, made some rather interesting observations.

First, he said that over the last 10 years, scores of basic science achievement tests have decreased less than scores in verbal achievement. Furthermore, when word problems are removed from the science and math tests, the scores showed even less of a decline.

He also stated that the scores on the advanced science and math exams have stayed level or actually increased over this time period.

Let's assume for the moment that his conclusions are correct. What is NSF doing to identify the effects of collateral issues, such as reading comprehension and language facility, on science and mathematics education?

Dr. KNAPP. I will have to submit the detailed answer to that for the record.

[The information follows:]

EFFECT OF COLLATERAL ISSUES ON SCIENCE AND MATHEMATICS EDUCATION

NSF has, and will continue to play an important role in supporting efforts to understand the relationships between the development of reasoning ability in science and mathematics and representational transformations (assimilating and expressing thoughts in spoken and written language including numerical and scientific notation, etc.). The Foundation encouraged and supported aspects of such work through its science education programs and through several of its research programs in the cognitive and information sciences.

It is because of this long-standing involvement that we know that we are not dealing with a difficulty with reading per se. The results of research and experience in teaching have shown that the difficulties students have in doing word problems are not primarily due to an inability to read. Most of the difficulties can be traced to inability to extract from the given information the relevant scientific concepts and to do the necessary quantitative reasoning to arrive at a solution to the problem. When questions on tests are asked without words (i.e., when the numbers to be used are presented directly), part of the thinking has been done for the student. This places a much less rigorous demand on higher order thinking skills and, consequently, test scores tend to be higher.

From our early involvement (mid-1960's) with support of improvement in instructional programs for science in the elementary school, we have learned that the kinds of experiences characteristic of NSF-supported materials development projects lead to the improvement of language facility in younger children; that is, verbal expression, reading readiness, reading comprehension, and writing ability. Furthermore, the Foundation has assisted in the communication of these findings ("What Research Says To the Science Teacher," NSTA publication series).

The science education program has supported several projects directed to the issue of reasoning (learning in mathematics and science) and language development (including modes of communication). We plan to continue our support of projects in this area and will continue to work jointly with the NSF basic research programs to examine this issue.

SCIENCE AND ENGINEERING EDUCATION PROGRAM ASSESSMENT

Dr. KNAPP. One of the programs that the National Science Foundation will have in its science and engineering education program will be an assessment of the success or failure of the programs that we are coming forward with as they affect students. This is a very difficult question to ask. The so-called SAT tests and so on don't necessarily measure the effectiveness of teaching programs. They are supposed to measure aptitude, not knowledge.

Senator GARN. I can guarantee that. I have a 17-year-old son who if you put his report card side by side with his SAT, you would think they had wrong names on one or the other of them because they certainly do not match. His SAT shows he is an intelligent young man. His report card shows he is an idiot. [Laughter.] After three children who got virtually straight A's, I don't know how to cope with this one. [Laughter.]

Dr. KNAPP. Testing and evaluation is a big part of the problem that we are looking at. We have not decided how to approach that problem. We realize it is very important.

Senator GARN. What I am getting at and suggesting here, Dr. Knapp, is simply that I believe we have to take a systems approach to education, and that means to me that we have to identify all of the components of the educational process that need improvement and how they interact with each other and which ones need improvement.

I realize that is difficult to determine as well. But if you will, and you have already indicated you will, indicate in your science education plan how you intend to identify and deal with these collateral issues.

DEFICIENCIES IN LANGUAGE SKILLS

Dr. KNAPP. It is absolutely true, as a final comment, that you cannot separate parts of education one from the other, that a deficiency in language will make a very serious problem in scores, say, in science or mathematics tests. Then again, our stated goal to affect the science and mathematics education of all students, not just those who are destined to be scientists or engineers or mathematicians, means that we have to address these problems, the problems of general education, the problems of education in all areas and how they interact with our particular small area.

We are working very closely with parts of the Department of Education, in particular the NIE and its Director. We are discussing joint programs with them. They would be quite interested, I think, in the broader issues that you mentioned.

Perhaps Dr. Good would like to make a comment.

Dr. GOOD. I would make a comment on the following issue. The question you raise is extraordinarily important. In the industrial sector, we are presently using a lot of resources that we should use otherwise in taking the science and engineering product that comes out of the universities.

If you ask R&D directors today what is the major weakness in the engineering and science students they get, the reply would be that the students have great difficulty in writing well and they have great difficulty in presenting coherent statements on their feet. Both are enormously important in industry. You have to be able to write coherent reports on what it is that you are trying to do. Their ability to do that is not very high. All of us spend an inordinate amount of money trying to correct this. There are businesses in the United States that do very well, and we hire them to come into our laboratories and teach those people how to write and speak.

Senator GARN. The problem is not peculiar to science and math education.

Dr. GOOD. No.

Senator GARN. I think it shows almost complete failure of the educational system to teach people how to read and write.

Dr. GOOD. That is right.

Senator GARN. And to speak. I am absolutely amazed. I speak of my own children who, with the exception of one, did very well in school. [Laughter.]

But I am also amazed at their spelling and some of their skills in that area. So it isn't just science education.

I don't know the answer as to how the whole school system across the United States seems to have failed so badly in the basic skills that schools are supposed to teach to begin with. That gets off into another argument about the three R's and the basics and so on. But the evidence is so overwhelming I find it hard we have experimented with phonics and new math and all sorts of things. Some of us who didn't have the pleasure or displeasure of receiving all of those methods seem to be able to write and speak and spell a little bit with the archaic education we had when you are in advanced middle age, like I am. [Laughter.]

SUBMITTED QUESTIONS

Dr. Knapp, I have some good news and some bad news for you. The bad news is I have questions for you from Senator Huddleston. I have 91 pages of additional questions for you. The good news is I am going to let you respond to them in writing. [Laughter.]

We appreciate very much both of you coming today and the responses of your staff. We look forward to continuing to work with you. Thank you very much.

Dr. KNAPP. Thank you, sir.

[The following questions were not asked at the hearing but were submitted for response for the record:]

QUESTIONS SUBMITTED BY SENATOR GARN

OMB REQUEST

Question: Please submit for the record a table containing your initial request to OMB for FY 85 and the levels contained in your FY 85 Budget Request. Please use the same level of detail as appears on pages NSF-34 through NSF-45 of your Budget Justification.

Answer: The following table compares the FY 1985 NSF submission to the Office of Management and Budget with the approved submission to the Congress. Since the initial request was made at the subactivity level, a comparison at the program element level is not possible.

The FY 1985 Request to OMB was submitted rounded to the nearest million dollars. As a result, there are minor differences between the actual planned program levels.

NATIONAL SCIENCE FOUNDATION
COMPARISON OF FY 1985 OMB REQUEST
TO THE CONGRESSIONAL REQUEST
(Dollars in Thousands)

	FY 1985 Request to OMB	FY 1985 Request to Congress	Difference Cong/OMB
MATHEMATICAL AND PHYSICAL SCIENCES			
Mathematical Sciences	$ 55,000	$ 50,500	$ -4,500
Computer Research	44,000	39,350	-4,650
Physics	130,000	121,770	-8,230
Chemistry	98,000	92,090	-5,910
Materials Research	126,000	113,000	-13,000
Subtotal, MPS	453,000	416,710	-36,290
ENGINEERING			
Electrical, Computer, and Systems Engineering	51,000	44,730	-6,270
Chemical and Process Engineering	35,000	32,530	-2,470
Civil and Environmental Engineering	41,000	39,760	-1,240
Mechanical Engineering and Applied Mechanics	35,000	30,080	-4,920
Subtotal, ENG	162,000	147,100	-14,900

Senator Garn—Continued

COMPARISON OF FY 1985 OMB REQUEST
TO THE CONGRESSIONAL REQUEST
(Dollars in Thousands)
(Continued)

	FY 1985 Request to OMB	FY 1985 Request to Congress	Difference Cong/OMB
BIOLOGICAL, BEHAVIORAL, AND SOCIAL SCIENCES			
Physiology, Cellular and Molecular Biology	125,000	116,360	-8,640
Biotic Systems and Resources	62,000	59,880	-2,120
Behavioral and Neural Sciences	45,000	42,280	-2,720
Social and Economic Science	29,000	28,000	-1,000
Information Science and Technology	7,000	6,600	-400
Subtotal, BBS	268,000	253,120	-14,880
ASTRONOMICAL, ASTMOSPHERIC, EARTH, AND OCEAN SCIENCES			
Astronomical Sciences	$ 98,000	$ 93,400	$ -4,600
Atmospheric Sciences	104,000	98,540	-5,460
Earth Sciences	49,000	48,600	-400
Ocean Sciences	132,000	124,940	-7,060
Arctic Research Program	8,000	8,000	0
Subtotal, AAEO	391,000	373,480	-17,520
SCIENTIFIC, TECHNOLOGICAL AND INTERNATIONAL AFFAIRS			
Industrial Science and Technological Innovation	24,000	23,400	-600
International Cooperative Scientific Activities	6,000	5,500	-500
Policy Research and Analysis	5,000	4,700	-300
Science Resources Studies	4,000	4,300	300
Research Initiation and Improvement	10,000	9,000	-1,000
Subtotal, STIA	49,000	46,900	-2,100
PROGRAM DEVELOPMENT AND MANAGEMENT	73,000	70,902	-2,098
TOTAL, RESEARCH AND RELATED ACTIVITIES	1,396,000	1,308,212	-87,788

Senator Garn—Continued

COMPARISON OF FY 1985 OMB REQUEST
TO THE CONGRESSIONAL REQUEST
(Dollars in Thousands)
(Continued)

	FY 1985 Request to OMB	FY 1985 Request to Congress	Difference Cong/OMB
U.S. ANTARCTIC PROGRAM			
U.S. Antarctic Research Program	11,000	11,000	0
Operations Support	98,000	104,080	6,080
TOTAL, U.S. ANTARCTIC PROGRAM	109,000	115,800	6,080
SCIENCE AND ENGINEERING EDUCATION			
Graduate Research Fellowships	$ 29,000	$ 21,000	$ -8,000
Undergraduate Engineering Education	12,000	-0-	-12,000
PreCollege Science and Mathematics Education	66,000	54,700	-11,300
TOTAL, SCIENCE AND ENGINEERING EDUCATION	107,000	75,700	-31,300
SPECIAL FOREIGN CURRENCY PROGRAM			
Research and Related Activities	4,000	2,800	-1,200
TOTAL, SPECIAL FOREIGN CURRENCY PROGRAM	4,000	2,800	-1,200
TOTAL, NATIONAL SCIENCE FOUNDATION	1,616,000	1,501,792	-114,208

Senator Garn—Continued

ESTIMATED NUMBER OF PROPOSALS AND AWARDS

Last year you estimated that 33,522 proposals would received in FY 84. This year's justification estimates the number of proposals at 34,670. Similarly, last year you estimated the number of FY 84 awards at 13,348 and your current estimate is 12,450.

So in comparison to last year you now expect more proposals and a lower number of awards.

Question: Do these changes in your estimates represent a policy decision on the part of the Foundation to "freeze" the number of grants at a lower level?

Answer: They do not. Being aware of the Committee's concerns, we have tried to increase the number of awards while providing more adequate support to investigators. Estimates are based on the best information available at the time they are made. The initial FY 1984 estimates were based on the Budget Request; the more recent estimates are based on the Current Plan.

Furthermore, there was uncertainty about several of the Foundation's proposed programs in January, 1983, when the first estimates were made. The Science and Engineering Education Activity is most notable. In addition, programs such as the Presidential Young Investigator Awards were new. Since then, the uncertainty has been reduced and the estimates of January 1984 are based on more current experiences. The new estimate for the number of awards in FY 1984 is 12,377 and the estimate for the number of proposals is the same as the earlier estimate of 34,670.

In the past you have indicated that the Foundation should strive to increase the size of grants and the number of senior scientists funded in any one grant. Consequently, there would be a smaller number of grants overall

Question: What advantage do you see in this policy?

Answer: As we have stated in our Justification of Estimates, such a policy permits a more adequate support of research, especially with regard to instrumentation and the number of senior investigators. Instrumentation is vital for the advance of most scientific and engineering disciplines. It is also costly and the most likely thing to be cut or delayed when budgets are inadequate. As a result, quality research is more difficult and the Federal investment does not pay off as it might.

Investment in instrumentation pays off in another way as well. Many engineers, scientists, and graduate students who are not directly supported by the Foundation nevertheless benefit educationally as well as scientifically from the availability of advanced research instrumentation to which they often have access for their own uses.

Increased award size also allows for greater numbers of senior scientists, postdoctorals, and graduate students to participate in forefront research using the best instrumentation available.

Question: Isn't it a fact that from a management standpoint it is easier to administer a small number of big grants than a larger number of smaller grants?

Answer: Not necessarily. It would be more accurate to say that the management problems would depend on the nature and requirements of the research being pursued. This will vary among and within the various science and engineering disciplines.

SCIENCE EDUCATION - UNOBLIGATED BALANCES

You expect in FY 83, a carryover of $13.9 million in your science and engineering education program. This, in addition to the $75 million made available by Congress, would result in a program level of $88.9 million for FY 84. Your FY 85 budget requests $75.7 million and you do not expect any carryover from FY 84. Thus your FY 85 program level will be $13.2 million less than the FY 84 level.

Question: In what specific areas would you expect to make this $13.2 million reduction during FY 85?

Answer: $13.9 million carried over from FY 1983 consisted of $11.4 million for Materials Development and Research and $2.5 million for Teacher Development and Incentives. Awards totaling $11.0 million have been committed. The final $2.6 million of FY 1983 funds are in the final stages of the recommendation process from the Division of Precollege Education in Science and Mathematics. Thus we will have essentially the same funds available in 1984 ($75 million) as in 1985 ($75.7 million). The level of support for precollege activities will be the same in both years, $54.7 million while graduate fellowships will increase $0.7 million from $20.3 million to $21.0 million.

Question: Given the fact that you are not able to obligate all of your FY 83 funds when only $30 million was appropriated, do you really expect that you will be able to obligate the entire $88.9 million during FY 84?

Answer: We will have no difficulty obligating the Graduate Fellowship funds. Our ability to obligate the Precollege funds is in large measure a function of the rate of receipt of high quality proposals which cannot be predicted precisely. We believe it will be difficult to fully obligate all FY 1984 SEE funds by the end of the fiscal year and in spite of our best efforts we may have as much as $30 million remaining.

Question: How much has been obligated to date?

Answer: As of the March 23, $11,000,000 of FY 1983 funds have been committed or awarded.

In explaining why you were not able to obligate all of the FY 83 funds you stated that because an approval was required by both appropriations committees the FY 83 science ed plan was delayed nearly 6 months.

Question: Could you please tell us how much of this 6 month delay was associated with NSF's preparation of the initial plan submitted to the committee? How much of the remaining time was associated with the Foundation's revision of that plan?

Answer: The initial plan was submitted by NSF to the committee on January 21, 1983. The committee responded on February 17, 1983. The second plan was submitted by NSF on April 14, 1983. The committee responded on April 15, 1983.

Question: What percent of the proposals that you expect to fund in science education during FY 84 will be unsolicited proposals and what percent will represent proposals that were solicited by the Foundation to address particular needs identified by NSF?

Answer: The term "solicited proposals" generally refers to responses to "Request for Proposals" (RFP's). The NSF at present does not plan to issue any RFP's in 1984. However, a program announcement for Precollege Science and Mathematics Education, issued in December 1983, contains descriptions of "particular needs" for which proposals are invited. These needs include:

- o New and improved materials and technologies for students;
- o New materials, models and demonstration for both the undergraduate preparation and the continuing education of science and mathematics teachers;
- o Research on teaching and learning;
- o Local/regional teacher training programs;
- o Incentive and recognition programs for outstanding teachers;
- o Improved programs for learning science and mathematics in informal settings such as in museums;
- o Studies and analyses of national and international conditions and developments in precollege science and mathematics education.

As targets of opportunity present themselves, RFP's will be issued, most probably in the areas of studies and analyses.

Senator Garn—Continued

SCIENCE EDUCATION -- PRECOLLEGE MATERIAL DEVELOPMENT AND RESEARCH

In FY 85 you are requesting a total of $27.7 million to support your Precollege Material Development and Research program in science education. This represents approximately 51% of the total available for science education -- other than for graduate felowships. This ratio is in keeping with the Senate recommendation on your FY 84 appropriations.

Question: Could you please describe the types of activities that would qualify for funding under the title "Precollege Materials Development and Research"?

Answer: The types of activities that qualify for funding under the area of "Precollege Materials Development and Research" are intended to provide new knowledge and products of eventual widespread interest and use to teachers and other educators. The development of new or improved science and mathematics instructional materials for students and teachers is a major component. Another emphasis is research and development on advanced technologies, particularly the computer, as they pertain to precollege science and mathematics education.

Support will be provided for applied and basic research projects aimed at the factors influencing the teaching and learning of science and mathematics.

Included also is the development of models and demonstrations and related materials to improve the preparation of undergraduates who are preparing to become precollege science and mathematics teachers and for the continuing education of teachers who are either currently teaching science or mathematics or who hope to acquire the necessary background to do so after having taught other subjects.

Projects will also be supported that aim to ensure that new materials and research results are effectively brought to the attention of teachers and other users across the Nation.

Question: Would you please provide for the record a list of the specific activities that would be eligible for funding?

Answer: Activities elgible for funding would include, but not necessarily be limited to, the salaries of principal investigators and other scientists or science educators, graduate students, consultants, and teachers performing professional roles in projects. Also included might be stipends for teachers involved in testing materials or programs, necessary travel to meetings for dissemination of information on projects, and limited amounts of equipment and supplies.

SUPPLY OF SCIENCE TEACHERS

Last year we discussed a February 18, 1983 article that appeared in Science concerning the supply of science teachers. Two basic issues were raised in that article. One is that students majoring in education have weaker academic skills than students majoring in most other fields. And secondly, students are becoming more concerned with the financial rewards associated with their careers and consequently less interested in pursuing teaching.

Question: Given all the Congressional, Administration, and local interest in science education since last year, can you identify any specific actions that address these two important issues?

Answer: These are indeed important issues. The remedies require concerted efforts by many different segments of the educational arena. Many of the actions, in fact most, must be carried out at the state and local level and there is evidence that this is beginning to occur.

For example, recently, the Washington Post carried an article on the front page about a local area effort. George Mason University in Fairfax County is revising its program for education majors in an effort to have been taken more seriously and attract more and better students. Courses are being revised to be more substantive and rigorous and the required grade point average is being raised for education majors.

The 1983 report of the NSB Commission, Educating Americans for the 21st Century, detailed many efforts being undertaken at the state and local level to attract better students to preservice teacher preparation programs, to provide them with a stronger academic program, and to develop appropriate salary levels and recognition for effective in-service teachers.

The Federal government's role is one of leadership and standards-setting as they relate to making the teaching profession one that is attractive and rewarding. For example, the development of quality instructional materials, the building of awareness of the importance of science and technology to all Americans, and providing high level (even Presidential) recognition of excellence in teaching can be important catalysts in improving the quality of the nation's teachers.

POST-PERFORMANCE EVALUATION

Back in 1978 this Subcommittee began asking the Foundation to look into the benefits that might result from the evaluation of research projects funded by NSF. Since then the Subcommittees focus has centered on the feasibility of improving the peer review process by explicitly requiring a review of the researchers performance on the immediately preceding grant.

In January you submitted a final copy of your report. The report found that although about 80% of NSF grantees submit another proposal to NSF, reviewers received neither explicit instructions to rate the prior work nor criteria for their ratings.

The study concluded that some minor changes in the process of rating renewal proposals could be implemented which would result in obtaining better ratings of the prior work.

The reports contained 3 specific recommendations, I would like you to indicate how and when the Foundation intends to implement them.

- A request for an explicit rating of the prior grant activities using NSF-stated criteria;
- The identification of all proposals which have a prior grant as renewal proposals;
- Insistence that the proposer include a bibliography and "progress report" for any immediately prior grant.

Answer: In response to the recommendations made in the January 1984 Post-Performance Evaluation Report, NSF management has taken the following actions:

- A bulletin from the Office of the Director will be issued shortly to all NSF program directors instructing them to take previous research of the Principal Investigator into account, where appropriate, and document in the grant record that they have done so, including their estimate of the quality of the previous research using standards analogous to those used for reviewing proposals.
- The following sentence will be added to the National Science Board – approved criteria for proposal review to make it more specific: "Please include comments on the proposer's recent research performance."
- NSF Circular 147, which deals with External Peer Oversight, will be modified to require Advisory or Oversight Committees, in their tri-annual review of programs, to examine grant jackets to assure that program directors have taken into account the Principal Investigator's performance on preceding awards.
- Renewal proposals can now be identified. In the course of reviewing our Management Information System over the next few months, we will clarify the definitions to make certain that consistency of this data item is maintained.

Question: Could you please submit a copy of the report for the record?

Answer: The report follows.

THE NSF POST-PERFORMANCE EVALUATION STUDY

Introduction

This study of the NSF Chemistry Division's proposals for renewal of research support recommends methods that are applicable to all NSF disciplinary research grant programs. These programs, which comprise most of the Foundation's support of basic research, all aim at supporting research of the highest quality--that which ultimately makes the greatest contributions to scientific advances.

Studies of the long-term impact of NSF funding[1] have shown that these contributions are knowable only many years after the completion of the research. But the Congress needs a clearer view of the results of more recent funding of basic research and has directed NSF to conduct post-performance evaluations to meet this need. The Congressional concerns are that the completed research be of high quality, that prior performance be adequately taken into account in the decision process, and that the decision process not be biased by factors unrelated to the quality of the output. The purpose of the present study is to develop a systematic way of doing post-performance evaluation and to provide assurances that these concerns will be addressed and appropriate actions taken.

Until about 1978 post-performance evaluation of NSF activities, aside from what was done routinely in each program, was mainly restricted to large, coordinated funding mechanisms for basic research (e.g., Materials Research Labs) or educational or institutional support (e.g., the Science Development Program). The advantage was the existence of natural comparisons; the disadvantage, the failure to evaluate the bulk of the Foundation's awards.

In 1978 Senator Henry L. Bellmon of the Senate Appropriations Committee began to inquire into post-grant evaluation. Drs. Richard C. Atkinson and George C. Pimentel, The Foundation's Director and Deputy Director, respectively, testified about the renewal process, the advisory committees, and the refereeing of journal papers, but the Committee needed additional information. The result was that three programs were selected for evaluation: oceanography, chemistry, and the behavioral and neural sciences program.

The Ocean Sciences Research program was chosen to be evaluated first because its advisory committee was about to hold an oversight meeting. Dr. Atkinson laid down the basic design by specifying that the publications from a sample of 50 completed projects should be rated by the advisors just like proposals. The Foundation's evaluation staff added 25 non-NSF "projects," and also counted citations to the publications. This study was completed in 1980. The evaluation staff then started to evaluate the NSF Chemistry Division roughly as it had evaluated oceanography. It did not prove possible, however, to get reviews of the completed work, since the Chemistry Division's advisory committee declined to rate the projects and the NAS Committee on the Chemical Sciences also declined to participate after expressing some concern about appropriate comparison groups.

This aborted evaluation effort taught two procedural lessons: (1) the scientific community will accept only expert judgment of research results, but the community is very reluctant to rate completed work as a discrete operation, and (2) *ad hoc* comparison groups which would be generally accepted as valid comparisons with NSF-supported projects are very difficult to identify.

In July 1980, the Senate Appropriations Committee directed the NSF "to secure an independent third party to develop a methodology for post performance evaluation of scientific research endeavors." At the request of NSF the National Academy of Sciences (NAS) undertook this task in 1981. The results of this effort were presented in a report entitled, "The Quality of Research in Science." The NAS ignored the question of appropriate comparison groups and cautioned against post-grant peer review unrelated to the proposal-judging process, while praising pre-grant peer review as irreplaceable and virtually unaugmentable. The NAS asserted that, for Chemistry, adequate peer review of completed work exists in the renewal proposal jackets and that, since requests for renewal support follow nearly all awards almost all completed work will be reviewed in the renewal process.

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[1] Examples of long-term studies are the recently completed "Chemistry Patent Study" and the current study to assess the contribution of NSF-supported chemistry to the significant activities in chemistry as identified by the National Academy of Sciences (NAS) Committee on the Chemical Sciences. This latter study is appended to this report (Appendix 1) because it was described in some of the earlier correspondence with the Senate Appropriations Committee.

Subsequent correspondence with the Senate Appropriations Committee Staff, in particular Dr. Wallace Berger, led to the formulation of the study which is the subject of this report.

The study has two parts. One investigates the assertion that the renewal process provides an adequate evaluation of previous work. This investigation will either confirm the assertion or describe what is needed for the renewal process to yield adequate peer reviews of completed work. The other part of the study, to develop a method for doing post-performance evaluation, was done by actually carrying out such an evaluation of the Chemistry Division.

The following section summarizes the study's findings, recommendations, and conclusions. The first part contains the findings and recommendations on the adequacy of information from the renewal proposals for post-performance evaluation. The second part contains the findings and conclusions from the evaluation of the Chemistry Division. Two types of renewal proposals are discussed in this section, Regular and Accomplishment-based renewals. Roughly 25% of all renewal proposals are Accomplishment-based. These proposals are very short but have copies of papers from the prior work attached so that the principal evaluation is of the completed research. Since investigators can choose the kind of renewal proposal they wish to submit, those who believe that their research records are superior are more likely to submit Accomplishment-based proposals.

Summary of Findings and Recommendations on Adequacy

- -- Roughly 90% of all chemistry grantees submit another proposal to NSF. For all of NSF the figure is about 80%. About 10% of these later proposals are not currently identified as renewal proposals in the NSF system.
- -- Reviewers of renewal proposals will evaluate prior work. Close to 90% of renewal proposal jackets contain at least one review of prior work.
- -- The reviews of prior work in the renewal process yield ratings which are too few, ambiguous, and not valid measures of the quality of the prior work.

Recommendations

Some minor changes in the process of rating renewal proposals should promote reviews of prior work which are distinct from the reviews of the renewal proposal and would almost certainly and more easily yield more and better ratings of the prior work. These recommended changes are: (1) a request for an explicit rating of the specifically identified prior grant activities using NSF-stated criteria; (2) within reason, the identification of all proposals which have a prior grant as renewal proposals; (3) insistence that the proposer include a bibliography and "progress report" for any immediately prior grant. Inclusion of bibliographies and progress reports in all proposals will promote review of the prior work and allow NSF to develop bibliometric measures to supplement and check the peer ratings of the prior work. (Last year NSF added the requirement that publications resulting from the predecessor grant be specifically identified in the bibliography so that this change has already been accomplished.)

Summary of Findings and Conclusions from the Chemistry Evaluation

Our evaluation of the Chemistry Division relied on citations to publications yielded by the completed research as the measure of quality of the work of the prior grant. Reviewers' ratings of completed work were inadequate for our analyses for reasons stated above. [1] However, ratings obtained after the recommendations suggested in the previous section are implemented should be useful in future evaluations.

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[1] We did the analyses with these ratings as an additional measure of prior work quality, but the difficulty of interpreting them was another reason for deciding that these ratings were inadequate.

Findings

- Prior performance has little influence on the award decision.
- For Regular renewals the proposal ratings have by far the greatest influence on decision.
- For Accomplishment-based proposals, which are rarely declined, the professional age of the investigator influences the decision, about as much as proposal ratings. Older investigators tend to be declined more often than young.
- For Regular renewals none of the four variables, citations, department ratings, investigator age, or requested amount, influence the ratings of renewal proposals.
- For Accomplishment-based renewals older investigators from higher ranked departments get higher proposal ratings than predicted by citations to their prior work.
- Young investigators at the time of their first renewal receive neither harsh nor preferential treatment.
- There were 10 cases (approximately 10%) of all renewal proposals that were exceptional in that (1) the prior grant proposal ratings were either very low or very high and the post-performance ratings of the prior grant were reversed, or (2) the decision on the renewal proposal was poorly predicted by the rating of the renewal proposal or the post-performance rating of the prior grant. Investigation into the reasons for the exceptions yielded nothing noteworthy except that for three cases the prior performance had little influence on proposal ratings or the award decision.
- There is no evidence that proposed or completed research judged original by reviewers is better (higher proposal ratings, more citations) than other, nor are there quality differences between theoretical and empirical research. Purely facilitative research is inferior but rare.

Conclusions

The use of citations to earlier research for post-performance evaluation shows that while NSF does fund its better projects, prior work quality has a surprisingly small effect on the award decision either directly or through its effect on proposal ratings.

Contributing to this statistical result were three decisions which were exceptionally badly predicted. For these three, prior performance was sharply discordant with renewal proposal ratings and decisions. Requiring distinct ratings of the prior work in the assessment of renewal proposals may lessen such discordance.

For young investigators seeking their first renewal grants, the quality of their prior work should be a most important variable. We found that they received neither harsh nor preferential treatment, but this conclusion is tenuous since our sample contained few of their proposals. We expect that renewal proposals which are subjected to review of prior work will eventually yield enough data to test conclusions about the treatment of young investigators.

Besides the quality of prior work, we believe that the other variables used in this study should be used in future analyses. It is important to know what does and what does not influence the award decision. We found that the professional age (i.e., years beyond the doctorate) of the investigator had a strong influence on decisions about Accomplishment-based renewals. A possible explanation for the greater tendency to decline renewals of some older investigators is that they rely on their good track record to offset poor proposals. If so, some further clarification of Accomplishment-based renewal criteria may be called for.

Another variable that yielded an interesting result is prior funding. For Regular renewals we found that previous support has a marginal effect on the decision: i.e., in addition to considering proposal quality, NSF tends to award renewals to projects with large earlier funding. This effect, though small, seems reasonable since a significant investment may have been made in building up a laboratory.

We found no evidence of bias in favor of particular departments. The higher ratings that mail reviewers give to proposals from older investigators from higher-rated departments may be simply because these proposals are better.

Finally, we found little to suggest that originality of research could be used to supplement peer ratings of the quality of the prior work. We believe that burdening reviewers with the task of rating proposals for originality is not worth the effort.

Analyses

The following analyses are based on data obtained from a random sample of FY 1982 chemistry renewal proposals and their prior grants. The data used in the analyses were: post-ratings of the prior grant; citations to publications yielded by the prior grant; age of the principal investigator; quality rankings of the institution; renewal proposal ratings; ratings of the proposal for the prior grant; size of the award for the prior grant; the proposed amount for the renewal; and originality of the prior grant proposal and the completed work.

The Chemistry Division recorded 217 renewal proposals in FY 1982, of which 161 are Regular renewals and 56 Accomplishment-based renewals. NSF asks that up to six recent reprints of publications from a prior grant accompany the brief Accomplishment-based proposals. The (probability) sample of 97 proposals (45% of the 217) is stratified to contain enough awards and declines for both types of renewal proposals, Accomplishment-based and Regular, to permit comparative analyses.

Dr. Kenneth Hicks, a chemist, joined our staff to analyze the data on the quality of the prior work contained in the renewal proposals. He determined from the reviewers' comments whether they were commenting on the quality of the work from the grant preceding the renewal proposal and if so, their rating of its quality. He also rated the confidence he had in making the ratings as a group. Since the confidence rating varied only with the number of ratings, we made no further use of it in the analyses. In addition, he recorded the year of the investigator's Ph.D. and whether the renewal proposal included a bibliography or a final progress report for the prior grant. Finally, he classified the prior completed research and the proposals for that work as: (1) theoretical (restricted to theory), empirical (relying on observation or experiment), facilitative (development of an instrument, technique, data gathering, tables). (2) original (fresh, unusual, new) or derivative (pulling together or sharpening the work of others). The data are in the Appendix 2.

Part I - Adequacy of Information in Chemistry Division Renewal Proposals

Renewal Proposals

A renewal proposal usually seeks support for continuation of prior work. Some other proposals contain reviews of a prior grant's work but are not identified as renewals and hence would not be included in a post performance evaluation based on an examination of renewal proposals. Also excluded would be renewal proposals which are not properly coded. A post-performance evalution based on renewal proposals is adequate if virtually all NSF basic research awards are followed by renewal proposals and reviews. For the Chemistry Division about 84% of all chemistry awards are followed by renewal proposals which are coded as such and about 90% which are renewals in the broader sense of having a prior grant. The 90% figure is slightly higher than the NSF average.

Ratings of Prior Work from the Renewal Proposal

All of the reviews of prior work in the renewal proposals are narratives (see Appendix 3). The reviewers of renewal proposals are not instructed to give a quality rating to the prior work, nor are they provided with criteria for rating its quality. Our NSF chemist reviewer had to translate the narratives into quality ratings, assuming that the statements on quality were based on criteria roughly paralleling those used in rating the original proposal. Further, the comments frequently did not specifically identify the work being commented on. In many instances he could only determine that some prior work was reviewed. Therefore, the task was difficult and time consuming, while admitting of possible ambiguities in the translation of the comments into ratings and in the identification of the work cited.

Two kinds of ratings were obtained from the narrative reviews:

- o T ratings, which were ratings explicitly of the work of the preceding grant
- o S ratings, which were ratings of some prior work

Table 1 shows for each type of renewal proposal an estimate from the sample of the number of renewal proposals with 0, 1, 2, 3, 4, or 5 or more reviews of some prior work (S ratings) and just the work of the preceding grant (T ratings).

Overall, about 80% of all renewal proposals contained T ratings. The average number of T ratings per rated proposal is 2 1/4. For Accomplishment-based renewals about 93% contain T ratings. If we use the scope and frequency of proposal review as the norm (i.e., review of the completed work should be as good as review of the proposed work) then Accomplishment-based renewal proposals are close in scope (93% vs. 100%) and short in frequency (2.2 vs. about 5).

Although T ratings are highly correlated with renewal proposal ratings, there is some evidence (Table 2 below) that they are not a rating of the work of the prior grant. The T ratings are highly correlated (.48) with S ratings (ratings of a body of work possibly larger than just the work of the prior grant) and not correlated with citations to publications yielded by the prior grant. Citations are much more highly correlated with T ratings for young investigators, where the recent work may represent their entire publishing history, than with older investigators where these citations comprise only a part of their record (correlation .48 compared to .04). A comparision between Accomplishment-based renewals and other renewals raises further questions about the validity of the T ratings as a rating of the quality of the prior work. In Table 2 we see that T ratings are negatively correlated with citations for Accomplishment-based renewals but positively correlated for Regular renewals. But we would expect the immediately prior performance to have the greatest influence on ratings for Accomplishment-based renewals. Similiarly, T ratings are more strongly correlated with proposal ratings for Regular renewals than for Accomplishment-based renewals.

T ratings are related to proposal ratings. The correlations are strong (they are even stronger for S ratings). However, it is difficult to interpret the T ratings. They do not appear to be a post-performance measure of the work of the prior grant. Citations to the body of work yielded by the prior grant are better--they are correlated with proposal ratings, and the correlation, as it should be, is higher for Accomplishment-based renewals.

Table I.

Estimates* of Numbers of All Chemistry Division Projects with Number of Prior Work Ratings by Type of Renewal Proposal and Type of Prior Work Ratings

Some Prior Work

Type of Proposal	Ratings per Project						
	0	1	2	3	4	5 or more	Total
Regular	24	70	36	15	0	10	156
Accomplishment-based	11	14	13	9	10	4	61
	35	84	50*	24	10	14	217

The Prior Work of Preceding Grant

Type of Proposal	Ratings per Project						
	0	1	2	3	4	5 or more	Total
Regular	38	29	41	27	10	10	156
Accomplishment-based	4	16	17	14	5	5	61
	42	45	59*	42*	15	15	217

Either Some Prior Work or the Prior Work of Preceding Grant

Type of Proposal	Ratings per Project						
	0	1	2	3	4	5 or more	Total
Regular	7	16	17	46	21	48	156
Accomplishment-based	0	0	6	8	22	26	61
	7	16	23	54	43	76	217

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*These are weighted estimates for all 217 FY 1982 Chemistry renewal proposals based on our sample of 97 proposals. Therefore, it is possible for columns not to add because of rounding of estimates obtained from the sample.

Table 2

Correlations

	T Rating			S Rating			Citations		
	C[1],	REG,	A.B.	C,	REG,	A.B.	C,	REG,	A.B.
T Rating				.48	.48	.46	.04	.32	-.37
Renewal Proposal Rating	.39	.42	.28	.57	.61	.39	.23	.13	.29

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[1] Combined, Accomplishment-based plus Regular renewals.

The Within-Proposal Consistency of the Ratings of the Prior Work

From the stratified sample of 97 FY 1982 renewal proposals, a subsample was chosen in such a way that it is a simple random sample of FY 1982 renewal proposals. The random subsample contains 46 renewal proposals, and 37 of them have T ratings. These 37 were used to estimate the within-proposal consistency of the ratings of prior work.

The within-proposal standard deviation of the average of 2.2 ratings of prior work per proposal from each of the 37 proposals is .47. This is a measure of inconsistency and slightly underestimates the expected difference between two ratings of the same proposal -e.g., Very Good to Excellent/Very Good.

A within-proposal standard error of .47 is low--i.e., the ratings of prior work are unusually consistent. As a comparison, the within-proposal standard deviation of the renewal proposal ratings for the subsample is .65, and of all FY 1981 chemistry proposals in the Fairness Study[1] is .63.

Three explanations of this high consistency for T ratings come to mind:

(1) It is easier to judge completed work than proposals.

(2) Comments on the prior work are more likely when the prior work is obviously good or bad.

(3) Our reviewer may have done some smoothing of inconsistent comments when he turned them into ratings.

Whatever the explanation for the low within-proposal standard deviation of the ratings of prior work, it is not so low as to cast much further doubt on their validity.

Information for Reviewers and Bibliometric Analysis

To determine whether the renewal proposals contained enough information for the mail reviewers to assess the quality of the prior work, renewal proposal folders were examined to see if they contained publications, a bibliography, and a progress report on the prior grant work. Fifty-four percent of the renewal proposals had publications from the prior grant, while 78% had publications from some prior work. Almost all of the renewal proposals had bibliographies, but our chemist reviewer could not always identify the publications yielded by the prior grant. About one-half of the proposals specifically noted in the bibliography the publications from the prior grant.

In order to get the citation data used in analyses of the next part of this study, all the publications which could not be identified with the specific prior grant were searched for their acknowledgement of support.

Overall, 88% of the renewal proposals contained a separate section reporting on the progress made under the prior grant. Of the renewal proposals where we were unable to get reviews of prior work, 17% had no progress report, but of the renewal proposals where we were able to get reviews of prior work, 10% had no report. The chance of getting reviews is better if the separate section/progress report is included.

Conclusions

It is not surprising that the ratings obtained for the study were difficult to interpret. Reviewers received neither explicit instructions to rate the prior work nor criteria for their ratings. Further, the manner in which the ratings were obtained (i.e., a chemist interpreting reviewers' comments about prior work that are in the renewal proposal jackets) introduced further ambiguities.

We are encouraged, however, by the large number of reviews commenting on prior work. The suggestion to review prior work of Accomplishment-based proposals is stronger and results in more such reviews. Explicit instructions to rate the prior work, what work to rate, and the criteria for rating should provide ratings more like those of proposals. A requirement that proposers designate all publications attributable to the prior grant and provide a progress report[1] as part of the renewal proposal would promote better reviews and better post-performance evaluations. However, if ratings of the prior work are muddled because of reviewers' knowledge of the proposal or the investigators, then the ratings from the revised procedure will be as difficult to interpret as those of this study. Finally, proper coding of declined renewal proposals and treatment of all proposals with prior grants as renewals will substantially increase the number of NSF awards available for post-performance evaluation. With these changes, the renewal process should provide adequate information for post-performance evaluation of the bulk of NSF research programs.

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[1] The most recent Fairness Study is " A Study of the Fairness of the NSF Award Decision Process," August 1982.

Part II - Post-Performance Evaluation of Chemistry

This part of the study demonstrates a method of doing post-performance evaluation which assesses the quality of research output. In order to identify possible improvements in the decision process, the evaluation investigates the quality of recently-completed research in chemistry and the factors which influence the award decision. Although the ratings of prior work obtained from a sample of FY 1982 renewal proposals, as described in the previous section, would have provided a measure of output, there are deficiencies in these rating data, as described above. Instead, citations to publications yielded by the prior grant were used in most of the analyses. In addition to quality ratings of prior work and of renewal proposals factors investigated for their effect on the award decision were grant size, rank of the investigator's department, and age of the investigator. The relationship between the originality and the quality of the research was also examined.

Factors which Influence the Award Decision

Our primary purpose was to examine the effect of prior work quality on the decision to award a renewal grant. We took citations to the completed work as the measure of its quality. We also did analyses using T ratings obtained from the renewal proposal reviews as a measure of prior work quality, but the analyses are not reported here because we concluded (cf. the Adequacy section above) that T ratings are a doubtful measure of the quality of the prior work.

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[1] A short final report and bibliography is already required of all grantees, but it is typically submitted some time after the renewal proposal.

In addition to citations we looked at the NAS[1] rating of the department of the proposer, the professional age of the proposer, and money--the amount spent on the completed project and the amount requested for the renewal. Finally, we singled out eight projects of young principal investigators submitting their first renewal proposals.

Our method was to look just at the simple normalized difference (an F-statistic; significant at the 5% level if greater than 4.1) between a variable's average for award and average for decline. Then a stepwise discriminant analysis procedure[2] was used to determine the variables which had a significant marginal effect on the award decision. In this procedure the averages of the other variables are adjusted by the variable with the greatest normalized difference and a new set of normalized differences are calculated. The variable giving the new largest difference is then used as an additional adjusting variable, and so on. This procedure identifies the variable with the greatest effect, the next greatest, and so on.

Finally, we examined the contributions that the variables made to proposal ratings. We looked at the simple regression of renewal proposal rating average on each of the other variables separately and then entered them in a multiple regression in a stepwise way quite like the one just described.

In what follows the terms citations and money are used, but the citations are corrected citations and the analysis was done in terms of the logarithms of both corrected citations and money. The citations were adjusted [3] for the length of time of the project. Two projects started well into 1981 and were given the value "missing" for corrected citations.

Award/Decline Comparisons

In order to improve the comparison of awards and declines, we augmented our (probability) sample with declines; otherwise we would have gotten only about 20% declines. Moreover, some Accomplishment-based renewal proposals were added because, as we suspected, they are different. In the remainder of this section the analyses will be done separately for Regular (Reg) proposals with roughly equal numbers of awards and declines and Accomplishment-based (AB) proposals with 31 awards and 7 declines. (There were only 9 AB declines in the universe of all Chemistry Division FY 1982 renewal proposals.) The universe mix of AB and Reg is roughly 1/4 AB with 90% awards and 3/4 Reg with 75% awards.

An important evaluation question is: Are the renewed projects better (for whatever reason)? They are. The average Chemistry Division award in FY 1982 had 29 1/2 citations while the average decline had 19 1/2. The F-statistic associated with this difference is 3.9 (significant at the 5.5% level).

Table 3 shows award/decline comparisions for Reg and AB proposals separately. For each type of proposal there are two columns of F-statistics (squared t-statistics). The first is for the simple comparison. The second is for the stepwise comparision as described above.

For Reg grants, the renewal proposal rating overwhelmingly explains award/decline differences. The departmental rating of awardees is significantly higher, but it is higher because proposers from higher rated departments get higher renewal proposal ratings. (F drops from 4.4 to 1.4 when adjusted for renewal proposal rating.) Even the significant difference in citations is partly explained by the highly cited getting higher renewal proposal ratings. Only the total funding for the prior work seems, marginally at least, to be a consideration of the program beyond the renewal proposal ratings.

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[1] An Assessment of Research Programs in the United States; Mathematical and Physical Sciences, NAS Press, Washington, D.C. 1982.

[2] See SAS Institute, Inc., SAS Users Guide; Statistics 1982 Edition. Cary N.C., 1982., Pages 405-414.

[3] An adjustment was used rather than entering elapsed time as a variable into the analyses, because citations increased with elapsed time but then decreased. The inferior "stale" projects were excluded from the adjustment calculation.

AB proposals are slightly better than Reg proposals and a lot less variable. Partly because of this lack of variation, the renewal proposal rating does not explain award nearly as well as for Reg proposals. In fact, the professional age difference is statistically the largest one for AB proposals and is significant even when adjusted for renewal proposal rating. (A third column of F's for AB proposals had to be added to show this.) In other words, beyond proposal ratings the age of the investigator has a significant effect on the award decision. (The older investigators tend to be declined.)

Correlates of Renewal Proposal Ratings.

Table 4 gives information about the contribution to average renewal proposal ratings of citations, department rating, age, and requested amount. Two columns of F-statistics are given for each type of proposal. The first shows the F associated with the equation containing only one variable. The second F is a measure of the improvement in fit to the ratings when a variable is added to those with a higher F. An F greater than 4.1 for a variable means that the improvement is significant at the 5% level.

Table 3.

Simple and Sequential Award/Decline Comparisons for Regular (Reg) and Accomplishment-based (AB) Proposal
(Significance Levels in Parentheses)

	REG				AB				
	Award Average	Decline Average	F	F for Sequential Entry	Award Average	Decline Average	F	F for Sequential Entry	F for Sequential Entry-Renewal Rating Forced in First
Renewal Proposal Rating Average	4.42	3.69	58.2	58.2	4.44	4.09	6.8	3.4	6.8
Corrected Citations	30	17	4.3	3.1	34	27	1.0	.0	.0
Department Rating	3.4	2.8	4.4	1.4	3.2	2.7	1.2	.8	.8
Professional Age	17.9	18.4	.0	.0	18.4	27.8	7.4	7.4	4.0(.05)
Total Funding for the Prior Work (thousands of dollars)	155	127	3.3	3.8(.06)	136	143	.1	.0	.0
R^2				.59(.00)				.28(.06)	.28(.06)

Table 4.

First and Sequential F´s-to-enter for the Regression of Renewal Proposal Rating Average on Four Variables. (Decimals in Parentheses are Significance Levels. Minus Signs Are Those of the Associated Coefficient.)

	REG		AB	
	F	F for Sequential Entry	F	F for Sequential Entry
Corrected Citations	1.0	.8	3.3(.08)	2.7
Departmental Ratings	1.1	1.1	3.3(.08)	4.3
Professional Age	.0	.0	3.9(.06)	3.9(.06)
Requested Amount	.4(-)	.4(-)	1.8	.0
R^2		.04(.70)		.26(.04)

The results for Reg proposals are easily summarized: These four variables have little influence on renewal proposal rating.

The renewal proposal ratings of AB grants are apparently influenced by professional age and department rating, and the combined effect of the two is greater than the sum of the separate effects. Age goes into the equation first just because its simple F of 3.9 is highest. (Its F for sequential entry is of course 3.9, but when department rating enters, the F for age jumps to 4.9). Thus, older investigators from higher-ranked departments received higher renewal proposal ratings.

While citations affect AB ratings more than Reg ratings, the effect is small.

Young Grantees at the Time of Their First Renewal.

Proposers submitting their first renewal proposal and who obtained their Ph.D. in 1972 or later were singled out because of a suggested concern in the NAS study. Unhappily there were only eight of them; so the remarks here are quite tenuous.

All of the four awards and the four declines were predicted by the discriminant analyses. For all proposals the overall wrong prediction rate was 13%. This is certainly not evidence of bias on the part of the program; i.e., young investigators at the time of the first renewal receive neither harsh nor preferential treatment.

Identification of Exceptional Projects

To help identify projects which may be exceptional, the T ratings were used in conjunction with citations and proposal ratings of both the prior grant proposal and the renewal proposal, but in no case was the use of T ratings critical. By exceptional we mean that:

(1) the prior grant proposal ratings were either very high or very low and the post-performance ratings were the reverse (very high or very low is roughly the top or bottom 10%, respectively);

(2) the decision on the renewal proposal was poorly predicted by the renewal proposal ratings or post-performance ratings of the prior grant.

A total of 10 projects from our sample, or roughly 10% of all renewal proposals, were exceptional according to the above definition (Table 5). The results of our investigation into the reasons why they are exceptional are:

ES 337 - The proposal for the prior grant received four strong very good ratings and one fair rating which was discounted after detailed comments were received from the principal investigator.

ES 351 - The investigator came close to an award on prior proposals. The proposal was from a state not heavily supported, was novel, and had only one bad review. The program decided to take a chance.

ES 317 - The prior grant yielded publications which had a large number of citations. The proposal for the prior grant was rated low. However, it only received one low review (poor) which was discounted. The remaining reviews averaged out to 4.3, which is more like what the proposal rating should be in light of the large number of citations.

ES 373 - This was exceptional in that the proposal was very highly rated and the number of citations yielded by the publications was exceptionally large.

ES 313 - Although there was some disagreement among the reviewers, the renewal proposal ratings were with one exception low for renewal proposals. The performance on the prior grant was also low. The renewal proposal was to complete development of software for chemical analysis which would be useful primarily to biologists. Chemists did not like the proposal, but the program thought it was worth the additional support to complete the software development.

ES 349 - The investigator with a good performance on the prior grant (citation) was proposing an extension into new and different areas and the reviewers were extremely unimpressed.

ES 329 & 382 - Apparently poor performance (low citations) on the prior grant did not influence either the proposal reviewers or the program.

ES 360 - Although the prior work yielded publications which received large numbers of citations, the reviewers did not like the renewal proposal. There were many criticisms, and all the reviewers thought the proposal was too diffuse.

ES 356 - The renewal propoal was for a joint effort from a theoretical and an experimental investigator. Both reviewers and the program were concerned about lack of a convincing demonstration of joint work, previously or prospectively.

Originality of Research

Our chemist reviewer classified both the proposal for the prior grant and the completed work described in the renewal proposal as original (fresh, unusual, new) or derivative (pulling together or sharpening the work of others). The purpose of this investigation into originality of the research was to see if originality might be another indicator or correlate of quality.

It is such an indicator but only in a way that is limited and without much utility: Completed work which is original also tends to be of high quality (i.e., have more citations), but this tendency is weak and not statistically significant; there is no relationship between originality and quality ratings of the proposal for the completed work.

Our chemist reviewer also classified the proposed research and the completed research as theoretical, empirical or facilitative. We suspected that for chemistry there might be a hierarchy of research with theoretical at the top and facilitative at the bottom. We found only that purely facilitative research got the lowest proposal ratings and numbers of citations. However, less than 5% of all chemistry proposals are purely facilitative, while 78% are purely empirical and 13% are purely theoretical.

Table 5

Exceptional Projects

ES #	T Average	C	Pre Average[1]	Ren Average	Decision
337	2.67*	7*	3.5*	3.60	D
351	3.25*	65	3.75*	4.12	D
317	4.00	84*	3.70*	4.42	A
373	4.71	119*	4.95*	4.71	A
313	3.75	0*	3.80	3.67*	A*
349	4.00	30*	3.60	2.17*	D
382	--	4*	4.40	5.00	A*
329	--	2*	4.12	4.83	A*
360	--	72*	4.25	3.50	D*
356	5.00*	119*	4.38	3.58*	D*

ES = the project identifier
T Av = average of quality ratings of prior grant research from the mail reviewers' comments in the renewal proposal
C = Citations to publications yielded by the prior grant
Pre Av = Average of mail reviewers' ratings of the proposal for the prior grant
Ren Av = Average of mail reviewers' ratings of the renewal proposal
Decision = decision on the renewal proposal, A = award, D = decline

*Denotes values for each project which makes the project exceptional. Values for ratings which are less than 3.8 are considered very low and greater than 4.70 are considered very high. Citations fewer than 10 are very low and more than 70 very high.

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[1] Note that all values in the Pre Average column are the average ratings for the prior awarded grant.

Conclusions

The most important use of a rating of prior work quality is to clarify the factors which affect the award decision. Using citations as the measure of prior work quality, we found that the Chemistry Divison funds its better renewal proposals. We are also led to the conclusion[1] that prior work has, at best, a modest effect on a renewal award. For Reg proposals the effect, such as it is, seems to come more from the program than the reviewers. For AB proposals, the small notice paid by reviewers to prior work quality vanishes in the program's declination of older proposers. Also vanishing is the preference the reviewers of AB proposals have for older investigators from the higher-ranked departments. Since the AB type of proposal has only been used for three years, the research community may not yet be fully accustomed to the criteria and for judging it, some older investigators may have written proposals that are not just short but unacceptable to the program.

For Reg proposals the programs may be concerned to continue projects where substantial investments have already been made, particularly if the proposal ratings are about equal. This practice seems reasonable as long as the effect is small.

Nothing in our study suggests either harsh or preferential treatment for young investigators at the time of their first renewal.

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[1] Quite a different conclusion can be reached by accepting the ratings obtained from the reviewers of renewal proposal (T-ratings) as ratings of the prior work.

It is appropriate to use prior work ratings to help identify exceptional projects (i.e., very highly or very lowly-rated proposals or renewal decisions badly predicted by prior work ratings). Of the 10 projects we identified as exceptional, only three could not be readily explained. For these three, ratings and decision were discordant with prior performance.

The classifications of research (original/derivative and theoretical/empirical/facilatative) neither confirmed old conjectures nor suggested new ones.

APPENDIX 1

IMPACTS OF NSF FUNDING ON ADVANCES IN CHEMICAL SCIENCES

This study was mentioned in earlier correspondence on post-performance evaluation with the Senate Appropriations Committee and is a response to suggestions made in the National Academy of Sciences report, "The Quality of Research in Science," (1982). The study is an examination of the long term impacts of the NSF on advances in Chemistry. Dr. Kenneth Hicks who assisted the Evaluation Staff in the post-performance evaluation study also did this study.

Study Method

Members of the Committee of Chemical Sciences of the National Research Council were asked to name the more significant activities of Chemistry as practiced today which had advanced substantially, over the last 10-15 years. The list of 10 "High Points in Chemistry", along with comments from the members of the COSPUP subcommittee, were used to block out ten "High Point" areas. The contribution of NSF and others to these areas was then examined.

Reviewers were chosen from prominent researchers in each of the "High Point" areas by examining literature sources (Articles, Reviews and Monographs) and questioning NSF program officers (Chemistry, Biology, and Material Science). The criteria for selection of a reviewer was that the researcher be presently active in the "High Point" field. An effort was made to include, for a given area, names of investigators from different geographical regions, junior and senior investigators, and, when possible, investigators at large and small schools. A letter of inquiry was sent to reviewers which outlined the purpose of the study and the requested information on a given area. The letter stated in part, ". . . we would like to obtain from you a list of 5-7 seminal publications that in your professional judgment made the largest contribution to the initiation, development and/or major advancement to (name of High Point.)"

The replies of the mail reviewers for each "High Point" area are tabulated below. References said to be "seminal" by two or more reviewers are grouped together on the top half of each page. The number of reviewers listing each publication in their responses is also shown. In addition, the tabulation contains publications under the heading "Similar Author Groups", which were not listed by more than one reviewer (excluding) reviewers listing their own work, but were authored by an investigator(s) whose name(s) appeared more than once on the lists of publications supplied by the mail reviewers.

The table also shows the citation count for the "seminal" publications for two time periods, (1966-76) and (1977-82). The citation counts were obtained from the Science Citation Index. [1]

Table I preceedes the tabulation of seminal publications and shows the number of publications tabulated by "High Point" area and agency funding acknowledgments. The number of times the publication is listed by reviewers is taken as the contribution the agency which received the funding acknowledgement makes to the "High Point" area. The total contribution to a "High Point" area is the sum of the individual contributions. The contribution for publications which had more than one funding acknowledgement was divided equally among the different funding agencies. Table II shows each agencies contribution and its percent of the total contributions for each "High Point." Also shown in Table II is the agency which supported the first seminal work, i.e., the publication with the earliest publication date. This is indicated with an asterisk(*).

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[1] Citation counts were provided by Computer Horizons, Inc., N. J.

One high point area, Gene Synthesis, is not shown on Tables I and II. We received only two responses from mail reviewers, and both of these reviewers only listed publications which they themselves authored. For completeness these responses are included in the below.

Study Results

- The results of this study show NSF as the leading agency providing support for the seminal work in 4 of the 9 high point areas, Organic Photochemistry, Metal Clusters, Surface Modified Electrodes, and Solid State NMR.
- The Office of Naval Research was found as having provided greatest contribution in Conducting Polymers.
- NIH was the major contributor, in support of Asymmetric and Stereoselective Synthesis.
- Industry was the greatest contributor to Picosecond Spectroscopy and Guest-Host Complexes.
- In the area of Orbital Symmetry, Harvard University, (university group) was found to be the major provider of suport.
- Further examination of the funding sources shows support was provided by a variety of programs within NSF. The Chemistry and the Materials Research Division played prominent roles in funding these seminal projects. The Physics division and RANN were also found to have provided early support.
- The total contribution an agency makes to the 9 "High Point" areas together can be estimated if we assume the High Points are of equal importance. In terms of total contribution to all High Points we find: NSF provided 26.1%, with the Industry group second, 15.6%, and NIH third with 13.5%.
- The agencies which provided support of the "seminal" papers with the earliest publication date were identified for each "High Point" area: NSF-1 area, Japan-3 areas, Industry-1 area, ONR- 1 area, NSF joint with PRF - 1 area, NSF joined with NIH and Industry - 1 area, and university groups joint with G.L. Cabot Fund - 1 area.
- The 10th "High Point" area of Gene Synthesis was not included because of lack of data. From the data received we estimate NIH and NSF the strongest followed by USPHS. The publication with earliest date was jointly sponsored by NCR (Canada), NIH, NSF, USPHS and Life Insurance Medical Research Fund, with the writen acknowledgment NCR (Canada) as the earliest supportor.
- The use of Bibliometric techniques in post performance evaluation studies is an accepted and valuable tool as it provides an overview of peer judgment. It has been shown that citation counts and other bibliometric indicates increase along with increases for other measures of scientific quality. Thus citation counts can be used to indicate publications which, in the judgement of that community of investigators, best represent the outstanding achievements and contributions for that field. Citation counts obtained for this group of "seminal" publications, were found to corroborate the findings taken from the responeses of the reviewers. On only one occasion (Solid State NMR) did citation counts indicate a greater importance to a publication than shown by the responses of the reviewers. However, the seminal contribution of that investigatior had been recognized by the reviewers through a listing of another publication.

Table I. Siminal Publications by "High Point" Areas and funding Agency

Each entry is the number of publications acknowledging agency support.

The numbers in parenthesis under each High Point heading is the total number of different publications

Agency	Organic Photochem (17)	Metal Clusters (10)	Conducting Polymers (7)	Surface Modified Electrodes (13)	Picosecond Spectroscopy (16)	Guest-Host Complexes (5)	Orbital Symmetry (11)	Stereo-selective Synthesis (4)	Solid State NMR (12)
NSF	10	8	2	12	3	1	1	2	6
NIH (HEW)	6[d]	-	-	-	1	1	3	2	1
AEC	3	-	-	-	-	-	-	-	-
ONR	-	-	2	-	-	-	-	-	3
DOE	-	1	-	1	-	1	-	-	-
INDUSTRY	1	2	-	-	11[c]	2[e]	-	-	1
DEFENSE	-	4[a]	-	4	-	-	-	-	3
UNIVERSITY	1	1	-	-	-	-	9[b]	-	-
JAPAN	-	-	3	-	-	-	2	1	-
GERMANY	-	-	-	-	1	-	-	-	-
ITALY	-	3	-	-	-	-	-	-	-
PRF	-	1	-	2	-	-	-	-	-
SLOAN FUND	2	-	-	1	-	-	-	-	1
CABOT FUND	1								
ROYAL SOCIETY	-	1	-	-	-	-	-	-	-
NO ACK.	-	-	-	-	-	-	-	-	2

(a) Includes support from NATO
(b) Harvard University
(c) Bell Laboratories
(d) Includes 1 from USPHS
(e) Du Pont

Table II. **Contributions of Funding Sources to "High Point" Areas.**

Each entry is the sum of the number of times a seminal publication acknowledging an agency is cited by the reviewers divided by the number of different agencies the publication acknowledges

Agency	Organic Photochem	Metal Clusters	Conducting polymers	Surface Modified Electrodes	Picosecond Spectroscopy	Guest-Host Complexes	Orbital Symmetry	Stereo-selective Synthesis	Solid State NMR	Average % Weighted Responses
NSF	11.5	9.83*	2	15*	2.5	.5	1	2	9.5	25.9
NIH(HEW)	8[d]	-	-	-	.5	.5	8	5	2	13.3
AEC	7	-	-	-	-	-	-	-	-	2.5
ONR	-	-	9	-	-	-	-	-	4.5*	7.6
DOE	-	0.67	-	3	-	-	-	-	-	1.6
DEFENSE	-	2.5[a]	-	5	-	-	-	-	4	5.1
UNIVERSITY	1*	0.5	-	-	-	-	22	-	-	7.6
ITALY	-	1.5	-	-	-	-	-	-	-	.9
INDUSTRY	0.67	2	-	-	16*[c]	4*[e]	1	-	3	15.7
JAPAN	-	-	6*	-	-	-	3*	2*	-	7.3
GERMANY	-	-	-	-	5	-	-	-	-	2.2
PRF	-	0.5	-	3*	-	-	-	-	-	1.6
SLOAN	.83	-	-	2	-	-	-	-	1	1.6
CABOT	1*	-	-	-	-	-	-	-	-	0.3
ROYAL SOCIETY	-	0.5	-	-	-	-	-	-	-	0.3
NO ACK	-	-	-	-	1	3	-	-	4	6.2
TOTAL	30	18	17	28	25	8	35	9	28	99.7

(*) Support agency(s) for the first seminal publication(s) in that "High Point" area.

(a) Includes support from NATO

(b) Harvard University

(c) Bell Laboratories

(d) Includes 1 from USPHS

(e) Du Pont (*)

ES #500

Organic Photochemistry

Responses 10/10

Order Number	Reviewer Citations	Funding Source	Citation Count	References
#1	3	NSF-CHE HEW-NAPCA	95+32 = 118	-S. Mazur and C.S. Foote, J. Am. Chem. Soc., 92,3225 (1970)
	3	NSF-CHE, NIH	105+69 = 174	-P.D. Bartlett and A.P. Schapp, J. Am. Chem. Soc., 92, 3223 (1970).
	3	AEC	108+ 32= 140	- G.S. Hammond, N.J. Turro, A. Fischer, J. Am. Chem. Soc., 83, 4674 (1961).
#2	2	NSF-CHE	256+ 55= 311	- Foote, C.S., Wexler, S. J. Am. Chem. Soc., 86, 3879,3880 (1964).
	2	G.L.Cabot Fund , M.I.T. Solar Energy Conversion Project	30+ 5= 35	- Buchi, G., Kofron, J.T., Koller, E., and Rosenthal, D., J. Am. Chem. Soc., 78, 876 (1956).
	2	AEC-(Argonne Natl. Lab.)	88+13= 101	- Wilzbach, K.E. and Kaplan, J., J. Am. Chem. Soc., 87, 4004 (1965).
	2	NIH	52+ 0 = 52	- T.J. Katz, E.J. Wang and N. Acton, J. Am. Chem. Soc., 93, 3782 (1971).
	2	NSF-CHE, NIH , Mobil Foundation	17+24 = 41	- O.L. Chapman, C.L.McIntosh and J. Pacansky, J. Am. Chem. Soc., 95, 6134 (1973).
	2	U.S. Public Health Service	64+20= 84	- Dauben, W.G. and Cargill, R.L., Tetrahedron, 15, 197 (1961).
	2	NSF-CHE	53+22 = 75	- H.E. Zimmerman and D.I. Schuster, J. Am. Chem. Soc., 83, 4486 (1961).

Similar Author Group

Order Number	Reviwer Citations	Funding Source	Citation Count	References
	1	NSF-CHE	76 +31 = 107	- G.S. Hammond, P. Wyatt, C.D. DeBoer, and N.J. Turro, J. Am. Chem. Soc., 86 2532 (1964).
	1	NSF-CHE	42 + 3= 45	- N.J.Turro, W.B.Hammond, P.A.Leermakers, JACS, 87, 2774 (1965).
	1	AEC-(Argonne Natl. Lab.)	70+23= 93	- K.E. Wilzbach and L. Kaplan, J. Am. Chem. Soc., 88, 2066 (1966).
	1	AEC-(Argonne Natl. Lab.)	69+6 = 75	- Kaplan, L.; Walzbach, K.E.; Brown, W.G.; Yang, S.S. J. Am. Chem. Soc., 87, 675 (1965).
	1	NSF-CHE, A.P. Sloan Fellowship(*)	90+43= 133	- P.E. Eaton and T. Cole(*) J.A.C.S., 86, 3157 (1964).
	1	NSF-CHE, NIH, A.P. Sloan Fellowship(*)	71+24= 95	- P.E. Eaton and T. Cole(*) J. Am. Chem. Soc., 86, 962 (1964).
	1	NSF-CHE	= 41	- Eriksen, J.; Foote, C.S.; Parker, T.L. J. Am. Chem. Soc., 99, 6455 (1977).

ES # 501

Responses 4/4

Metal Clusters

Order Number	Reviewer Citations	Funding Source	Citation Count	References
#1	3	NSF-CHE	= 97	- R.B. Calvert and J.R. Shapley, J. Am. Chem. Soc., 99, 5225 (1977).
#2	2	NSF-DMR, NSF-CHE, DOE	= 182	- E.L. Muetterties, T.N. Rhodin, E. Band, C.F. Bucker, and W.R. Pretzer, Chem. Rev., 79, 91 (1979).
	2	The Royal Society, NATO, Univ. of Wisc. Consiglio Nazionale delle Ricerche	4+179 = 183	- P. Chini, Adv. in Organometallic Chem.,14, 285(1976).
	2	Union Carbide Corp.	= 58	- R.L Pruett, Ann. New York Acad. Sci., 295 ,239 (1977).
	2	NSF, Defense Adv.Res.Projs.	15+205 = 220	- E.L. Muetterties, Bull. Soc. Chem. Belg., 84, 959 (1975).
	2	NSF-CHE	= 42	- M. Tachikawa and E.L. Muetterties, J. Am. Chem. Soc.,102, 4541 (1980).

Similar Author Groups

Order Number	Reviwer Citations	Funding Source	Citation Count	References
	1	NSF-CHE	69+40 = 109	- L.F. Dahl, et al, J. Am. Chem. Soc., 89, 261 (1967).
	1	NSF-CHE	80+53 = 133	- E.R. Corey, L.F. Dahl, and W. Beck, J. Am. Chem. Soc., 85, 1202 (1963).

	1	CNR(Italy), NATO, Snam-Progetti	= 32	- P. Chini, Gazz. Chim. Ital., 109, 225 (1979).
	1	CNR(Italy) NATO	= 32	- P. Chini, J. Organomet. Chem., 200, 37 (1980).
	1	NSF-CHE PRF	6+69 = 75	- J.B. Keister and J.R. Shapley, J.A.C.S., 98, 1056 (1976).

ES# 502

Responses 8/10

Conducting Polymers

Order Number	Reviewer Citations	Funding Source	Citation Count	References
#1	7	Office of Naval Research	8 +227= 235	- C.K Chiang, C.R. Fincher, Y.W. Park, A.J. Heeger, H. Shirakawa, E.J. Louis, S.C. Gau, and A.G. MacDiarmid, Phys. Rev. Letters, 39, 1098 (1977).
#2	3	--- (Japan)	4+128= 130	- T. Ito, H. Shirakawa and S. Ikeda, J.Poly.Sci. Polym.;Chem. Ed., 12, 11(1974)
#3	2	--- (Japan)	12+213= 225	- E. Shirakawa, T. Ito and S. Ikeda, Polym. J., 4, 460 (1973).
	2	Office of Naval Research	= 141	- H. Shirakawa, E.J. Louis, A.G. MacDiarmid, C.K. Chiang, and A.J. Heeger, Chem. Comm., 578 (1977).

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Order Number	Reviwer Citations	Funding Source	Citation Count	References
	1	--- (Japan)	12+152= 174	- H. Shirakawa, and S. Ikeda, Poly. J., 2, 231 (1971).
	1	NSF	= 123	- W.P. Su, J.R. Schrieffer and A.J. Heeger, Phys. Rev., B22, 2099 (1980).
	1	NSF-MRL	= 0	- P.J. Nigrey, A.G. MacDiarmid and A.J. Heeger, Mol. Cryst. Liq. Cryst., 83, 309 (1982).

ES #503

Responses 6/7

Surface Modified Electrodes

Order Number	Reveiwer Citations	Funding Source	Citation Count	References
#1	5	NSF-CHE Defense Adv.Res. Projs.	11+113 = 124	- P. R. Moses, L. M. Wier and R. W. Murray, Anal. Chem., 47, 1882 (1975)
#2	4	NSF-CHE PRF	(a) 17+94 = 111 (b) 14+50 = 64	- R. Lane and A. T. Hubbard, J. Phys. Chem., 77, 1401, 1411 (1973). (a) (b)
	4	NSF-CHE *A.P. Sloan Fellow.	12+119 = 131	- B. F. Watkins, J. R. Behling, E. Kariv and L. L. Miller* , J. Am. Chem. Soc., 97 3549 (1975).
#3	3	NSF-CHE Army Research Office	= 101	- A. Merz and A. J. Bard, J. Am. Chem. Soc., 100, 3222 (1978).
	3	DOE	= 70	- M. S. Wrighton, R. G. Austin, A. B. Bocarsly J. M. Bolts, O. Haas, K.D. Legg, L. Nadjo an M. C. Palazzotto, J. Am. Chem. Soc., 100 1602, (1978).
#4	2	NSF-CHE PRF	= 64	- L. L. Miller and M. R. Van De Mark, J.A.C.S., 100, 3223, (1978)

Similar Author Groups

Order Number	Reviwer Citations	Funding Source	Citation Count	References
	1	NSF	= 42	- J.P. Collman, M. Marrocco, P. Denisevich, C. Koval and F.C. Anson, J. Electroanal. Chem. 101, 117, (1979).
	1	NSF, Army Research Office	= 36	- N. Oyama and F.C. Anson, J. Electrochem. Soc., 127 247, (1980).
	1	NSF-RANN	0+75 = 75	- A.P. Brown, C. Koval, and F.C. Anson, J. Electroanalytical Chem., 72, 379 (197
	1	NSF-MPS	1+75 = 76	- P.R. Moses and R.W. Murray, J. Am. Chem. Soc., 98, 7435 (1976)
	1	NSF	= 23	- H. Abruna, T.J. Meyer and R.W. Murray, Inorg. Chem., 18, 3233 (1979).
	1	NSF	2+60 = 62	- B. Firth, L.L. Miller, M. Mitani, T. Rogers J. Lennox, R.W. Murray, J. Am. Chem. Soc., 98, 8271 (1976)
	1	NSF, Defense Adv. Res. Proj.	1+64 = 65	- C. M. Elliot and R.W. Murray, Anal. Chem., 48, 1247 (1976)

ES #504 Picosecond Spectroscopy Responses 5/7

Order Number	Reviewer Citations	Funding Source	Citation Count	References
1	5	----- (Germany)	19+ 27= 46	- D. von der Linde, A. Laubereau & W. Kaiser, Phys. Rev. Lett., 26, 954 (1971).
2	2	General Tel. & Electronics Lab	30+ 38= 68	- R.R. Alfano & S.L. Shapiro, Chem. Phys. Lett., 8, 631 (1971).
	2	Bell Labs	28+ 67= 95	- C.V. Shank and E.P. Ippen, Appl. Phys. Lett., 24, 373 (1974).
	2	Bell Labs	216+ 51= 267	- J.A. Giordmaine, P.M. Rentzepis, S.L. Shapiro, & K.W. Weiss, Appl. Phys. Lett., 11, 216 (1967).
	2	Bell Labs	127+ 77= 204	- M.A. Duguay and J.W. Hansen, Appl. Phys. Lett., 15, 192 (1969)
	2	Bell Labs	92+ 24= 116	- P.M. Rentzepis, Chem. Phys. Lett., 2, 117 (1968).

Similar Author Groups

Order Number	Number of Citations			
	1	-----	= 104	- A. Laubereau & W. Kaiser, Rev. Mod. Phys., 50, 607 (1978)
	1	Bell Labs	2+ 57= 59	- E.P. Ippen, C.V. Shank, & A. Bergman, Chem. Phys. Lett., 38, 611 (1976).
	1	NSF-CHE, NSF-MRL	= 40	- B.I. Greene, R.M. Hochstrasser, & R.B. Weisemann, J. Chem. Phys., 70, 1247 (1979).
	1	NSF ,NIH Postdoc Fellowship	19+ 36= 55	- R.M. Hochstrasser, H. Lutz & G.W. Scott, Chem. Phys. Lett., 24, 162 (1974).
	1	NSF-CHE, NSF-MRL	= 8	- B.R. Greene, R.B. Weisman & R.M. Hochstrasser J. Chem. Phys., 71, 544 (1979).
	1	IBM, San Jose'	37+ 74= 113	- T.J. Chuang, K.B. Eisenthal, Chem. Phys. Lett., 11, 368 (1971).
	1	IBM, San Jose'	7 + 18= 25	- D. Rehm, K.B. Eisenthal, Chem. Phys. Lett., 9, 387 (1971).
	1	IBM, San Jose'	25+ 28= 53	- K.B. Eisenthal & K.H. Drexhage, J. Chem. Phys., 51, 5720 (1969).
	1	IBM, San Jose'	16+ 57= 73	- T.J. Chuang, G.W. Hoffman & K.B. Eisenthal, Chem. Phys. Lett., 25, 201 (1974).
	1	Bell Labs	44+ 50= 94	- G.E. Busch, R.P. Jones, & P.M. Rentzepis, Chem. Phys. Lett., 18, 178 (1973)

ES #505 | Guest-Host Complexes | Responses 5/7

Order	Reviewer Citations	Funding Source	Citation Count	References
1	3	(None Listed)	92+361= 453	- J.M. Lehn, Structure and Bonding., 16, 1-69 (1973).
2	2	----(Du Pont)	75+161= 236	- C.J. Pederson, J. Am. Chem. Soc., 89, 2495 (1967).
	2	----(Du Pont)	415+532= 957	- C.J. Pederson. J. Am. Chem. Soc., 89, 7017-7036 (1967).

Similar Author Groups

Order	Reviewer Citations			References
	1	NSF, NIH-Postdoc Fellowship	77+ 95= 182	- R.L. Van Etten, J.F.Sabastian, G.A. Clowes and M.L. Bender J. Am. Chem. Chem. Soc., 89, 3242 (1967)

Responses 7/8

ES # 506

Orbital Symmetry

Order Number	Reviewer Citations	Funding Source	Citation Count	References
1	6	NIH Fellowship(*)	286+84= 370	-H.C. Longuet-Higgins and E.W. Abrahamson(*) J. Am. Chem. Soc., 87, 2045 (1965).
2	5	Harvard Univ. Society Of Fellows(*)	19+136= 155	R.B. Woodward and R. Hoffmann(*) , J. Am. Chem. Soc., 87, 395 (1965)
	5	Harvard	98+42 = 140	R.B. Woodward and R. Hoffmann, J. Am. Chem. Soc., 87, 2046 (1965).
3	3	Harvard	325+74= 399	R. Hoffmann and R.B. Woodward, J. Am. Chem. Soc., 87, 2511 (1965).
	3	(Harvard)	735+352= 1097	R.B. Woodward and R. Hoffmann, Angew. Chem. Int. Ed. Engl., 8, 781 (1969
	3	NSF-CHE, NIH Wisc. Alumni Res. Foundation	101+85= 186	R.E. Zimmerman, J. Am. Chem. Soc., 88 1564 (1966).
	3	NIH, Prinction Univ. Fellowship Monsanto Fellowship	63+56 = 119	N.D. Epiotis, J. Am. Chem. Soc., 94, 1924 (1972).
4	2	(Harvard)	1 +1 = 2	R. Hoffmann, and R.B. Woodward, Angew. Chem., 81, 797 (1969).
	2	(Harvard)	165+41= 206	R. Hoffmann and R.B. Woodward, Accounts. Chem. Res., 1, 17 (1968).
	2	------(Japan)	123+78= 201	K. Fukui, T. Yonezawa, and H. Singu, J. Chem. Phys.,20, 722 (1952).

Similar Author Groups

Education Ministry, Japanese Gov.	116+69= 185	K. Fukui,T. Yonezawa,C. Nagata,and H. Singu, J. Chem. Phys., 22, 143 (1954).

(Harvard)-Research presented in these publications stems from work supported by Harvard Univ.

ES #507

Stereos7lective Syntheses

Responses 6/8

Order Number	Reviewer Citations	Funding Sources	Citation Count	References
# 1	4	NIH	69	- Katsuki, T.; Sharpless, K.B. J. Am. Chem. Soc., 102, 5974 (1980)
# 2	2	NIH , NSF-CHE	27	- Katsuki, T.; Sharpless, K.B. J. Am. Chem. Soc., 103, 6237-40 (1981)

Similar Author Groups

Order Number	Reviewer Citations	Funding Sources		References
	1	NSF-CHE	0	- Halpern, J., Science , 217, 401 (1982)
	1	Ministry Of Education, Japanese Gov.	(a) 48 (b) 39	- Noyori, R.; Tomino, I.; Toninoto, M. J. Am Chem. Soc., 101, 3129 (a) and 5843 (b) (1979)

ES #508

Solid State NMR

Responses 4/5

Order Number	Reviewer Citations	Funding Sources	Citation Count	References
1	5	NSF-PHYS, ONR	138+202= 340	- S.R. Hartmann and E.L. Hahn, Phys. Rev., 128, 2042 (1962).
2	4	NSF-CHE, NIH	70+ 72= 142	- A. Pines, M.G. Gibby and J.S. Waugh, J. Chem. Phys., 59, 569 (1973).
	4	NSF-CHE, Joint Services Electronics Program	87+ 96= 183	- J.S. Waugh, L.M. Huber and U. Haeberlen, Phys. Rev. Lett., 20, 180 (1968).
3	3	----(Monsanto)	1 +138= 139	- J. Schaefer and E.O. Stejskal, J. Amer. Chem. Soc., 98, 1031 (1976).
4	2	ONR, NSF Postdoc Fellowship	267+ 97= 184	- A.G. Redfield, Phys. Rev., 98, 1787 (1955).
	2	NSF-CHE, J.S.E.P.	87+ 97= 184	- U. Haeberlen and J.S. Waugh, Phys. Rev., 175, 453 (1968).
	2	----	24+ 15= 39	- E.R. Andrew, A. Bradbury and R.G. Eades, Arch. Sci., 11, 223 (1958).
	2	A.P. Sloan Foundation, Air Force Office Sci. Res.	45+ 67= 112	- I.J. Lowe, Phys. Rev. Lett., 2, 285 (1959).

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Order Number	Reviewer Citations	Funding Sources		References
	1	-----	38+ 55= 93	- E.R. Andrew, A. Bradbury, and R.G. Eades, Nature (London).,182. 1569 (1958).
	1	-----	= 88	- Schaefer, J., Stejskal, E.O., Buchdahl, R. Macromolecules, 10, 384 (1977).
	1	ONR	505+264= 769	- Hahn, E.L.: Phys. Rev.,80, 580 (1950)
	1	NSF	30+ 20= 50	- Rhim, W.K., Pines, A., Waugh, J.S. Phys. Rev.(B),3, 684 (1971).

ES #509

Gene Synthesis

Responses 2/9

Funding Sources	References
NSF, NIH, NCR(Canada)	H.L. Heyneker, J. Shine, H.M. Goodman and H.W. Boyer, J. Rosenberg, R.E. Dickerson, S.A. Narang, Keiichi Itakura, Syr-yaung Lin and A.D. Riggs Nature, 263, 748 (1976)
Genentech, Inc.	K. Itakura, T. Hirose, R.Crea, A.D. Riggs, H. Heyneker, F. Bolivar, H.W.Boyer Science, 198, 1056 (1977)

Genentech, Inc.	R. Crea, A. Kraszewski, T. Hirose, and K. Itakura Proc. Natl. Acad. Sci., 75, 5765 (1978)
USPHS	P. Dembek, Ken-ichi Miyoshi,and K. Itakura J. Amer. Chem. Soc., 103, 706 (1981)
Japan	H. Ito, Y. Ike, S. Ikuta and K. Itakura Nucleic Acids Research, 10, (1982)
USPHS	J.J. Rossi, R. Kierzek, T. Huang, P.A. Walker and K. Itakura J. Biol. Chem., 257, 9226 (1982)
USPHS	Z.K. Tan, S. Ikuta, T. Huang, A. Dugaiczyk and K. Itakura Cold Spring Harbor Symposia on Quantitative Biology, 47
NCR(Canada), NIH, USPHS, NSF, L.I.M.R.F.(*)	H.G. Khorana, 7 th. International Congress of Biochemistry, Tokyo, p.17, 1967.
NCR(Canada), NIH USPHS, U. of Wisc., L.I.M.R.F.(*), NSF	H.G. Khoran, Pure and Applied Chemistry, 17, 349 (1968).
NSF, NIH, USPHS, L.I.M.R.F.(*)	H.G. Khorana, H. Buchi, M.H. Caruthers, S.H. Chang, N.K. Gupta, A. Kumar, E. Ohtsuka, V. Sgaramella, and H. Weber, Cold Spring Harbor Symposia on Quantitive Biology, 33, 35 (1968).
NIH, L.I.M.R.F.(*), NSF, U. of Wisc.,	K.L. Agarwal, H. Buchi, M.H. Caruthers, N. Gupta, H.G. Khorana, et. al., Nature, 227, 27 (1970).
NIH, L.I.M.R.F.(*), NSF, USPHS	H.G. Khorana, K.L. Agarwal, H. Buchi, M.H. Caruthers, et. al., J. Mol. Biol., 72, 209 (1972).
NIH, USPHS, NSF, Am. Cancer Soc., Sloan Foundation	H.G. Khorana, K.L. Agarwal, P. Besmer, H. Buchi, et. al., J. Biol. Chem., 251, 565 (1976).
NIH, Sloan Found., Am. Cancer Soc., NSF	R. Belagaje, E. L. Brown, M. Gait, and H.G. Khorana, J. Biol. Chem., 254, 5754 (1979).
NIH, Sloan Found., Am. Cancer Soc., NSF	T. Sekiya, T. Takeya, E.L. Brown, R. Belagaje, R. Contreras, Hans-Joachim Fritz, M.J. Gait, R.G. Less, M.J. Ryan, and H.G. Khorana, J .Biol. Chem., 254, 5787 (1979).
NIH, Sloan Found., Am. Cancer Soc., NSF	M. Ryan, E. Brown, T. Sekiya, H. Kupper, and H.G. Khorana, J. Biol. Chem., 254, 5817 (1979).

(*)L.I.M.R.F.= Life Insurance Medical Research Fund

APPENDIX 2.

DATA USED IN THE POST-PERFORMANCE EVALUATION STUDY

Variable Definitions

ES	Evaluation Staff identification number.
ACH_BASE	Achievement based renewals have a value of 'A' and regular proposals have a value of 'R'.
ACTION	The decision on the renewal proposal. Awards are coded 'A' and declines are coded 'D'.
N_COM	Each renewal proposal has an associated completed project proposal. N_COM is the number of proposal reviewers on the completed project proposal.
AVG_COM	The average of the ratings of the proposal reviewers on the completed project proposal.
N_REN	The number of proposal reviewers on the renewal proposal.
AVG_REN	The average of the ratings of the proposal reviewers on the renewal proposal.
N_T	The number of renewal proposal reviewers who included comments on the quality of the prior work in their review of the renewal proposal.
T_AVG	Average of the prior work ratings that our reviewer assigned based on the renewal proposal reviewers comments on the prior work.
N_S	Same as N_T but the renewal proposal reviewers are commenting on some prior work not necessarily the prior work attributable to the completed project.
S_AVG	Average of the ratings that our reviewer assigned based on the renewal proposal reviewers comments on some prior work.
CHR	Mean rating of the scholarly quality of Chemistry faculty (scale = 0 to 50 as compiled by the Conference Board of Associated Research Councils and published in "An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences". NAS Press, 1982.
NPUB	The number of publications from the completed project.
TCITES	The total number of citations to the publications from the completed project in the Science Citation Index from 1977 through 1982.
MAX	The number of citations to the one publication in each project that received the largest number of citations.
DEGYR	The year of the highest professional degree of the principal investigator on the renewal proposal.
FIRST	This variable is coded 'Y' if the renewal proposal is the first renewal proposal from the principal investigator and 'N' otherwise.
COMP_AMT	Total dollars awarded to the completed project in thousands of dollars.
PROP_AMT	Proposed amount for the renewal proposal in thousands of dollars.
P_DUR	Proposed duration in months of the renewal proposal.
CLOSE	Our reviewers judgement on the closeness of the proposed work in the renewal proposal to the completed project work. (1=very close, 2=moderate 3=slight, 4=can't tell)
OVER_RAT	Our reviewers interpretation of the overall assessment of the proposal reviewers of the completed work.

PUBSP	Coded 'Y' if there was at least one publication from the prior work in the renewal proposal folder and coded 'N' otherwise.
PUBSO	Coded 'Y' if there was at least one publication from some prior work (not the prior work) in the renewal proposal folder and coded 'N' otherwise.
BIBSP	Coded 'Y' if there was a bibliography to the prior work publications in the renewal proposal folder and coded 'N' otherwise.
BIBSO	Coded 'Y' if there was a bibliography to some prior work publications in the renewal proposal folder and coded 'N' otherwise.
ORIG_COM	The completed project proposal is characterized as Theoretical(T), Empirical(E), Original(O), Derivative(D) and/or Facititative(F).
ORIG_REN	The proposed work in the renewal proposal is characterized as Theoretical(T), Empirical(E), Original(O), Derivative(D) and/or Facilitative(F).
REPT	Coded 'Y' if the renewal proposal had a progress report on the work from the completed project and 'N' otherwise.
WGT	The weight associated with each action in the sample. The weight is the inverse probability that an action was included in the sample.
SUBSAMP	Coded '1' if this action is in the random subsample and '0' otherwise.

Chemistry Data

ES	ACH_BASE	ACTION	N_COM	AVG_COM	N_REN	AVG_REN	N_T	T_AVG	N_S	S_AVG	CHR	NPUB	TCITES	MAX	DEGYR	FIRST	COMP_AMT	PROP_AMT	P_DUR	CLOSE	OVER_RAT	PUBSP	PUBSO	BIBSP	BIBSO	ORIG_COM	ORIG_REN	REPT	WGT	SUBSAMP
301	R	A	7	4.29	5	4.20000	2	4.00	1	4.00	28	5	7	3	1961	N	114.9	363.9	36	2	4.0	Y	Y	Y	Y	F	E	Y	4.83	1
302	A	A	6	3.92	5	4.70000	1	4.50	4	4.50	35	8	14	5	1963	N	187.1	292.9	36	2	4.5	Y	.	Y	.	E	E	.	1.63	0
303	A	A	5	4.20	5	4.60000	1	4.50	3	4.33	49	8	10	5	1952	N	190.0	266.6	36	4	4.0	Y	N	Y	Y	EF	EF	N	1.63	0
304	R	A	7	4.00	5	5.00000	3	4.83	1	5.00	37	12	61	17	1965	N	324.1	1191.8	36	2	5.0	Y	N	Y	Y	E	E	.	4.83	1
305	A	A	5	4.20	4	4.75000	1	5.00	1	4.50	11	9	10	4	1970	N	109.8	141.3	36	2	.	Y	N	Y	Y	E	E	.	1.63	1
306	R	A	5	4.10	6	4.25000	0	.	5	3.90	33	6	54	18	1953	N	160.0	268.5	36	2	.	N	N	Y	N	E	EF	Y	4.83	1
307	R	A	4	4.50	5	4.60000	3	4.83	2	4.00	49	11	59	14	1974	N	91.0	532.8	36	2	5.0	Y	N	Y	Y	E	TE	Y	4.83	1
308	R	A	3	4.83	5	4.80000	2	4.00	3	4.00	40	3	5	5	1948	N	212.0	255.6	36	2	.	N	N	Y	.	E	E	N	4.83	1
309	R	A	3	4.33	5	4.70000	2	4.50	1	4.00	29	2	6	5	1963	N	170.0	310.5	36	2	4.0	N	N	Y	Y	E	EF	Y	4.83	1
310	R	A	5	4.40	4	4.12500	0	.	1	4.00	39	1	1	1	1966	N	141.5	242.8	36	2	.	N	N	Y	Y	E	E	Y	4.83	1
311	R	A	5	4.00	5	4.50000	3	4.67	2	4.25	28	4	23	12	1966	N	213.8	293.3	36	2	5.0	N	N	Y	Y	E	E	Y	4.83	1
312	R	A	6	4.33	4	4.12500	1	4.50	2	4.25	49	4	12	12	1977	Y	145.5	441.2	36	2	.	Y	Y	Y	Y	E	E	N	4.83	1
313	A	A	5	3.80	6	3.66667	2	3.75	2	4.00	29	0	0	0	1958	Y	114.0	85.9	12	2	4.0	Y	N	Y	Y	F	F	Y	1.63	0
314	R	A	5	4.80	4	4.62500	1	4.00	3	4.00	46	4	74	45	1966	N	159.0	300.7	36	2	.	N	N	Y	N	T	T	N	4.83	1
315	A	A	5	4.70	4	5.00000	4	4.88	0	.	41	14	66	16	1975	Y	120.0	208.5	36	2	5.0	Y	N	Y	Y	T	TE	N	1.63	0
316	R	A	4	3.50	3	4.33333	0	.	0	.	44	3	1	1	1936	N	84.0	227.9	36	2	.	N	N	Y	Y	T	T	Y	4.83	1
317	A	A	5	3.70	6	4.41667	2	4.00	4	4.25	29	13	84	21	1951	N	84.0	170.0	36	2	4.0	Y	Y	Y	Y	T	T	Y	4.83	1
318	A	A	5	4.50	5	4.20000	3	4.67	2	3.75	40	4	29	20	1975	N	208.0	291.1	36	2	5.0	Y	Y	Y	Y	E	E	Y	1.63	1
319	R	A	5	4.40	7	4.50000	5	4.20	1	5.00	31	5	36	11	1949	N	124.5	190.6	36	2	4.5	N	N	Y	Y	E	EF	Y	4.83	1
320	R	A	4	4.38	6	4.00000	1	5.00	1	4.00	12	3	3	2	1961	N	144.0	225.3	36	2	.	N	N	Y	Y	E	EF	Y	4.83	1
321	R	A	6	4.00	7	4.42857	3	4.33	2	4.00	48	1	0	0	1955	N	56.0	378.1	36	2	4.5	N	N	Y	Y	E	E	Y	4.83	1
322	R	A	6	4.17	6	4.50000	2	4.50	1	4.00	39	22	103	20	1964	N	145.0	237.9	36	2	4.5	N	N	Y	Y	E	E	Y	4.83	1
323	R	A	5	4.40	5	4.20000	4	4.00	1	4.50	36	5	16	5	1971	N	153.3	237.7	36	2	4.5	Y	N	Y	Y	E	E	Y	4.83	1
324	A	A	6	4.50	5	4.60000	1	4.00	3	4.00	32	4	40	20	1970	N	84.9	220.1	36	2	4.0	Y	N	Y	Y	E	E	Y	1.63	0
325	A	A	5	4.60	3	4.66667	2	3.50	0	.	40	9	85	31	1967	N	185.6	318.5	36	2	3.5	Y	N	Y	Y	E	E	Y	1.63	0
326	R	A	5	4.60	3	4.66667	2	4.00	1	4.00	31	5	34	15	1965	N	181.0	301.9	36	2	4.0	N	N	Y	Y	E	E	Y	4.83	1
327	R	A	4	4.38	3	4.66667	1	5.00	1	4.50	35	2	4	3	1970	N	66.1	193.8	36	2	.	N	N	Y	Y	E	E	Y	4.83	1
328	R	A	5	4.10	5	4.30000	5	4.30	0	.	11	11	30	7	1970	Y	97.8	262.5	36	2	4.5	N	N	Y	Y	E	E	Y	4.83	1
329	R	A	4	4.13	6	4.83333	0	.	6	4.42	19	2	2	1	1974	N	129.0	152.1	36	2	.	N	N	Y	.	E	EF	Y	4.83	1
330	R	A	7	3.57	6	4.16667	2	4.00	1	4.00	21	5	20	8	1963	N	100.0	181.1	36	2	4.0	N	N	Y	Y	E	E	Y	4.83	1
331	A	A	8	3.91	5	4.40000	3	4.17	1	4.50	11	7	20	8	1974	N	125.7	139.5	28	2	4.0	Y	.	Y	.	E	TE	Y	1.63	1

Chemistry Data

ES	ACH_BASE	ACTION	N_COM	AVG_COM	N_REN	AVG_REN	N_T	T_AVG	N_S	S_AVG	CHR	NPUB	TCITES	MAX	DEGYR	FIRST	COMP_AMT	PROP_AMT	P_DUR	CLOSE	OVER_RAT	PUBSP	PUBSO	BIBSP	BIBSO	ORIG_COM	ORIG_REN	REPT	WGT	SUBSAMP
332	R	A	4	4.75	6	4.16667	0	.	1	4.00	44	2	11	7	1970	N	109.3	238.8	36	2	.	Y	Y	Y	Y	E	EF	Y	4.83	1
333	R	A	3	4.67	5	4.60000	1	4.50	2	4.00	37	9	36	12	1976	Y	199.1	247.1	36	2	.	N	N	Y	Y	E	F	Y	4.83	1
334	R	D	3	4.67	5	3.80000	2	3.75	2	3.75	18	0	0	0	1963	N	118.0	172.2	36	2	3.5	N	N	Y	Y	E	E	.	1.31	1
335	R	D	4	4.13	5	3.40000	0	.	0	.	44	2	1	1	1977	N	130.0	251.2	36	2	.	N	N	Y	Y	E	E	Y	1.31	0
336	R	D	6	4.33	7	4.28571	0	.	1	4.00	27	11	28	6	1963	N	112.0	240.9	36	2	.	N	N	Y	Y	E	E	N	1.31	0
337	R	D	4	3.50	5	3.60000	3	2.67	1	3.00	14	3	7	6	1969	Y	42.0	134.6	36	2	3.0	N	N	Y	Y	E	E	Y	1.31	0
338	R	D	5	4.00	4	3.75000	0	.	0	.	37	9	16	5	1949	N	136.0	311.2	36	2	.	N	N	Y	Y	T	T	Y	1.31	1
339	R	D	5	4.20	6	3.83333	1	3.50	0	.	20	10	23	4	1956	N	113.6	238.4	36	2	.	N	N	Y	Y	E	EF	Y	1.31	0
340	R	D	5	4.10	4	4.00000	0	.	3	3.67	31	4	9	6	1969	N	121.8	324.4	36	2	.	N	N	Y	Y	E	E	Y	1.31	0
342	R	D	6	4.33	5	3.20000	2	3.25	2	2.75	29	5	12	9	1957	N	185.4	358.6	36	2	3.0	Y	.	Y	.	E	E	Y	1.31	1
343	R	D	5	4.70	4	3.87500	1	4.50	3	3.83	11	5	17	8	1960	N	158.5	343.5	36	2	.	Y	Y	Y	Y	E	E	Y	1.31	0
344	R	D	5	4.10	6	4.16667	3	3.83	2	4.00	24	3	7	3	1961	N	146.0	300.7	36	2	4.0	Y	Y	Y	.	E	E	Y	1.31	0
345	R	D	3	4.17	6	4.00000	2	4.50	1	3.00	35	3	4	3	1960	N	78.0	239.8	36	2	4.5	N	N	Y	Y	E	E	N	1.31	1
346	R	D	5	4.10	5	3.20000	2	3.75	1	3.00	11	8	8	3	1963	N	114.9	214.4	36	2	3.5	N	N	Y	Y	E	E	Y	1.31	0
347	R	D	3	4.33	4	3.12500	2	3.00	1	4.00	31	8	12	4	1945	N	160.0	351.9	36	2	3.0	Y	.	Y	Y	E	E	.	1.31	1
348	R	D	4	4.25	7	3.71429	3	4.17	1	4.00	31	3	21	15	1971	N	122.0	255.0	36	2	4.0	Y	Y	Y	.	E	EF	Y	1.31	0
349	R	D	5	3.60	6	2.16667	1	4.00	0	.	49	4	30	17	1959	N	463.5	536.9	36	2	.	N	N	Y	Y	E	E	Y	1.31	0
350	R	D	6	4.33	4	3.87500	3	4.67	0	.	27	11	28	6	1963	N	112.0	263.5	36	2	4.5	N	N	Y	Y	E	EF	Y	1.31	0
351	A	D	6	3.75	4	4.12500	2	3.25	2	3.75	21	21	65	18	1965	Y	48.0	227.5	24	2	4.0	Y	.	.	.	TE	F	Y	1.29	0
352	R	D	7	4.43	5	3.90000	3	4.00	0	.	19	10	18	5	1962	N	96.0	175.6	36	2	3.5	.	N	Y	.	T	T	Y	1.31	1
353	R	D	5	4.20	5	3.70000	4	3.50	0	.	24	1	0	0	1976	Y	45.0	160.8	36	2	3.5	N	N	Y	Y	E	E	Y	1.31	0
354	A	D	5	4.40	6	3.95833	1	4.50	1	4.00	11	8	43	12	1953	Y	89.2	186.5	36	2	.	Y	Y	Y	Y	TE	T	Y	1.29	0
355	A	D	5	4.00	6	4.25000	0	.	5	3.40	37	9	16	5	1949	N	136.0	291.0	36	2	.	N	N	Y	Y	T	T	Y	1.31	0
356	R	D	6	4.38	6	3.58333	1	5.00	0	.	32	17	119	21	1974	N	72.5	164.3	36	2	.	N	N	Y	Y	TE	TE	Y	1.31	0
357	R	D	6	4.17	7	3.71429	2	4.00	1	3.00	11	4	26	11	1965	Y	60.0	216.9	36	2	4.0	N	N	Y	Y	T	T	Y	1.31	1
358	R	D	5	4.40	6	3.58333	2	4.00	2	4.00	30	12	54	16	1975	Y	119.2	255.1	36	2	4.0	N	N	Y	Y	E	E	Y	1.31	0
359	R	D	5	4.00	6	3.70833	3	4.00	0	.	49	2	5	3	1975	Y	159.0	212.9	36	2	4.0	N	N	Y	Y	E	E	Y	1.31	0
360	R	D	4	4.25	3	3.50000	0	.	2	3.25	23	26	72	14	1960	N	80.0	197.5	36	2	.	N	N	Y	Y	E	E	Y	1.31	0
361	R	D	4	4.13	4	4.00000	0	.	2	3.75	14	9	27	9	1964	N	119.1	305.1	36	2	.	Y	N	Y	Y	E	E	Y	1.31	1
362	R	D	5	4.40	5	4.20000	0	.	2	3.75	39	1	0	0	1932	N	85.9	171.5	36	2	.	N	N	Y	.	E	E	Y	1.31	0
363	R	D	4	4.13	5	3.80000	4	4.38	0	.	31	4	2	1	1972	Y	106.0	331.4	36	2	4.5	N	N	Y	Y	E	E	Y	1.31	0

Chemistry Data

ES	ACH_BASE	ACTION	N_COM	AVG_COM	N_REN	AVG_REN	N_T	T_AVG	N_S	S_AVG	CHR	NPUB	TCITES	MAX	DEGYR	FIRST	COMP_AMT	PROP_AMT	P_DUR	CLOSE	OVER_RAT	PUBSP	PUBSO	BIBSP	BIBSO	ORIG_COM	ORIG_REN	REPT	WGT	SUBSAMP
364	A	D	.	.	6	3.91667	3	3.50	3	4.00	23	4	28	11	1965	Y	.	335.3	36	2	4.0	Y	.	Y	Y		EF	N	1.29	0
365	R	D	5	4.00	6	4.08333	2	3.50	0	.	37	2	0	0	1973	N	92.9	277.2	36	2	3.5	N	N	Y	Y	E	EF	Y	1.31	0
366	R	D	4	4.13	5	3.60000	4	4.25	1	3.50	33	2	5	3	1969	N	196.7	248.0	36	2	4.0	Y	Y	Y	Y	E	F	Y	1.31	1
367	A	A	5	4.20	5	4.20000	4	4.38	1	4.50	37	10	26	7	1963	N	121.3	306.5	36	2	4.5	Y	N	N	N	E	E	Y	1.63	0
368	A	A	6	4.33	4	4.37500	3	4.83	2	4.25	27	9	34	12	1957	Y	52.0	333.4	36	2	5.0	Y	N	Y	Y	E	E	.	1.63	0
369	A	A	5	4.80	6	4.25000	1	4.50	5	4.30	44	6	52	21	1959	N	155.0	391.8	36	2	.	Y	Y	Y	Y	E	E	Y	1.63	1
370	A	A	5	4.30	7	4.35714	5	4.40	0	.	11	9	28	7	1953	N	98.0	185.4	36	2	4.5	Y	N	Y	Y	EF		Y	1.63	0
371	A	A	5	4.20	6	4.33333	2	4.75	4	4.25	40	0	0	0	1960	N	226.4	437.8	36	2	4.5	Y	N	Y	Y	E	E	Y	1.63	0
372	A	A	8	4.19	5	4.20000	1	4.50	2	4.00	37	15	54	12	1967	N	188.2	275.1	36	2	.	Y	Y	Y	Y	E	E	Y	1.63	1
373	A	A	5	4.95	8	4.87500	7	4.71	1	4.50	37	12	119	47	1966	N	250.0	413.5	36	2	5.0	.	Y	Y	Y	E	E	Y	1.63	0
374	A	A	5	3.75	5	4.40000	2	4.50	1	4.50	22	12	48	11	1963	N	113.0	191.4	36	2	4.5	Y	N	Y	Y	E	TE	Y	1.63	1
375	A	A	5	4.60	6	4.83333	3	4.83	0	.	28	7	27	8	1962	N	97.0	188.0	36	2	5.0	N	N	Y	Y	E	F	Y	1.63	0
376	A	A	5	4.28	5	4.30000	1	4.00	3	3.83	19	9	90	25	1974	N	90.0	204.2	36	2	.	Y	Y	Y	Y	T	T	Y	1.63	0
377	A	A	5	4.20	3	4.66667	3	4.17	0	.	37	14	18	4	1970	N	112.0	205.2	36	2	4.0	Y	.	Y	Y	T	T	Y	1.63	1
378	A	A	5	4.80	4	4.75000	3	4.33	1	4.00	45	10	53	19	1969	N	150.0	260.3	36	2	4.5	Y	Y	Y	Y	T	T	Y	1.63	0
379	A	A	5	3.80	3	4.33333	4	3.88	0	.	36	5	15	7	1955	N	73.8	198.6	36	2	3.5	Y	N	Y	Y	T	T	Y	1.63	0
380	A	A	6	4.17	6	4.29167	3	4.33	1	4.00	39	4	20	9	1967	N	201.1	426.5	36	2	4.5	Y	Y	Y	Y	E	E	N	1.63	1
381	A	A	5	4.80	5	4.60000	3	4.83	2	4.50	23	19	66	9	1962	N	156.0	237.5	36	2	5.0	Y	Y	Y	Y	E	E	Y	1.63	0
382	A	A	5	4.40	4	5.00000	0	.	4	4.63	49	3	4	2	1963	N	160.0	376.4	36	2	.	Y	N	Y	Y	E	E	N	1.63	0
383	A	A	4	4.50	5	4.40000	2	4.25	2	4.00	30	9	36	11	1955	N	100.0	107.4	36	2	4.5	Y	Y	Y	Y	E	E	Y	1.63	1
384	A	A	4	4.31	5	4.45000	2	2.50	3	4.17	36	10	100	38	1964	N	174.6	277.3	36	2	4.0	Y	.	Y	Y	E	E	Y	1.63	0
385	A	D	5	4.35	4	4.00000	1	4.50	1	5.00	19	8	4	2	1960	N	98.7	147.9	36	2	.	Y	Y	Y	Y	E	E	Y	1.29	1
386	A	D	6	3.88	5	4.20000	2	5.00	2	5.00	44	2	1	1	1949	N	317.8	479.3	36	2	5.0	N	N	Y	N	TE	TE	Y	1.29	0
387	A	D	5	4.00	5	4.00000	5	4.60	0	.	31	4	8	6	1949	N	168.0	265.2	36	2	4.5	Y	N	Y	Y	E	E	Y	1.29	0
401	R	A	6	3.92	5	4.30000	2	4.50	2	4.00	37	15	207	33	1968	N	74.9	60.4	12	1	4.0	.	N	Y	.	E	E	.	1.00	0
402	R	A	5	4.55	4	4.25000	0	.	3	3.67	29	0	0	0	1949	M	64.0	24.1	12	2	.	N	N	Y	N	F	F	.	1.00	1
404	R	A	.	.	7	4.00000	2	4.00	3	4.00	36	4	5	2	1955	N	.	140.1	36	2	4.0	N	N	Y	Y		T	Y	1.00	0
405	R	A	5	4.60	5	4.60000	0	.	1	4.00	39	5	20	13	1957	Y	150.0	12.7	6	2	.	Y	.	Y	Y	T	T	N	1.00	0
406	A	A	5	3.80	8	3.93750	0	.	7	3.57	34	6	6	2	1944	N	116.0	238.5	36	4	.	Y	.	Y	Y	E	TE	Y	1.00	0
407	A	A	6	4.08	7	3.85714	1	4.00	3	3.83	32	2	3	3	1967	N	68.0	151.5	36	4	.	Y	Y	Y	Y	TE	T	Y	1.00	1
408	R	A	4	4.69	5	4.75000	4	3.75	1	4.00	44	5	14	6	1964	N	506.0	160.9	12	1	4.5	Y	.	Y	.	E	E	.	1.00	0
409	R	A	5	3.90	5	3.90000	0	.	2	4.00	37	6	47	12	1968	Y	105.0	42.0	12	1	4.0	N	N	Y	N	E	E	.	1.00	1
410	R	A	5	3.90	7	4.07143	0	.	2	2.50	33	2	35	31	1964	N	126.2	265.2	36	2	.	N	N	Y	Y	E	E	Y	1.00	0
411	A	A	6	3.96	6	4.08333	1	4.00	2	3.50	25	6	31	12	1976	Y	112.0	195.2	36	4	3.0	Y	Y	Y	Y	E	E	.	1.00	0
412	R	A	6	4.00	6	4.29167	0	.	3	3.50	18	3	17	10	1966	M	115.0	237.8	36	4	.	Y	N	.	Y	F	EF	.	1.00	0

APPENDIX 3.

REPRESENTATIVE COPIES OF PROPOSAL REVIEW SHEETS

Contained in this appendix are copies of proposal review sheets. The reviews are representative of the types of comments found throughout the study.

The overall ratings shown near the bottom of the review sheets are those provided by the mail reviewers. The reviewers are chosen by the chemistry program director to evaluate the proposal on the basis of their knowledge of the field. The annotated comments represent our interpertation of the reviewer's comments relating specifically to the previously completed work.

FOUNDATION

PROPOSAL EVALUATION FORM

NSF Form 2

PROPOSAL NO.

INSTITUTION

PLEASE RETURN BY

PRINCIPAL INVESTIGATOR

NSF PROGRAM

TITLE

Comments (continue on additional sheet(s) as necessary):
Quality of the proposed research (including budget and institutional capability):

The quality of the PI's research during the present grant period is very high. Dr. has made several significant contributions, and continues to be among the more active investigators in the field. The proposed research is both creative and valuable. Several new approaches to important problems are proposed, and the research, if brought to a successful conclusion, will add significantly to the available knowledge in the field. Dr. has both the experience and the ability to execute the research, and the facilities are adequate for the job.

The Data General Model 6026 tape drive is not really crucial to the proposed research. It would, of course, be convenient to have, but $15,500 is better spent in helping to support another investigator.

The overall budget is appropriate although perhaps a little large, i.e. two graduates in the second and third years instead of three would be more in line with work proposed.

Specifically the prior work

The prior work rated

Recent research achievements of the Principal Investigator(s):

In general, the PI has done excellent work. The development of good action variables for three-atom systems is a very important contribution. The development of the use of reference trajectories in gas-phase collisions also holds promise. The trajectory calculations of the PI are standard, but they have been done skillfully.

OVERALL RATING: ___ EXCELLENT ___ VERY GOOD ___ GOOD ___ FAIR ___ POOR

Verbatim but anonymous copies of reviews will be sent only to the principal investigator/project director. Subject to this NSF policy and applicable laws, including the Freedom of Information Act, 5 USC 552, and formal requests from Chairpersons of Congressional committees having responsibility for NSF, reviewers' comments will be given maximum protection from disclosure.

REVIEWER'S SIGNATURE

REVIEWER'S NAME (TYPED)

OTHER SUGGESTED REVIEWERS (OPTIONAL)

FOUNDATION

PROPOSAL EVALUATION FORM

NSF Form . 3

PROPOSAL NO.	INSTITUTION	PLEASE RETURN BY
PRINCIPAL INVESTIGATOR	NSF PROGRAM	
TITLE		

Comments (continue on additional sheet(s) as necessary):
Quality of the proposed research (including budget and institutional capability):

Comments (continue on additional sheet(s) as necessary):
Quality of the proposed research (including budget and institutional capability):

The research outlined in this proposal is of high quality. The proposed experiments are precisely the ones which should be carried out at this point in the development of multiphoton ionization (MPI). However, they are not extremely original. For instance, group at already is doing the Positive Ion Destruction Spectroscopy. None of the proposed experiments can be classified as being elegant, certainly not in comparison to what laboratory has produced in the past. But this is most likely because MPI is a new field in which we understand very little about the mechanism for fragmentation. Proposed work is rated [redacted] The prio work is rated

I would categorize the proposed work as being very good.

The past research from laboratory is of extremely high quality. This is true the work on MPI. most recent paper on the role of neutrals is especially good. The results clearly show that neutrals do not take part in the fragmentation processes. Anot paper I recall from lab which is not included in publication list because chose not to put name on the paper is one by which is a beautiful piece of work showing that in the MPI of DABCO the absorption of two photons le to a metastable state which can fluoresce. In short I rate previous work as excellent.

The equipment request is reasonable, although certainly expensive. I believe however that the amount of personnel is a bit high. Three graduate students and a postdoc appear to m to be too many for the work outlined. One and one or two and one might be more appropria

Recent research achievements of the Principal Investigator(s):

OVERALL RATING: X EXCELLENT X VERY GOOD ___ GOOD ___ FAIR ___ POOR

REVIEWER'S SIGNATURE	REVIEWER'S NAME (TYPED)
OTHER SUGGESTED REVIEWERS (OPTIONAL)	

PROPOSAL NO.
INSTITUTION
PLEASE RETURN BY
PRINCIPAL INVESTIGATOR
NSF PROGRAM
TITLE

Comments (continue on additional sheet(s) as necessary):
Quality of the proposed research (including budget and institutional capability):

has a growing reputation in inorganic chemistry. proposal shows a depth of knowledge and understanding of the subject which is admirable. The research project is well thought out and certainly capable of completion. It is a worthwhile project, though it is likely to raise more questions then it answers. However, this is certainly a good feature of a worthwhile piece of research. My only criticism might be that the opening few pages dealing with photochemical decomposition of water are, perhaps, tied on to the proposal for topical mission oriented-type reasons and yet do not seem to have such an obvious connection. Clearly one can find a connection, but it seems forced. On the other hand, would probably defend by saying that a more fundamental understanding of the photochemical processes involved in the systems under study would provide information leading towards a successful photocatalyst. I recommend that the project be granted.

It is difficult for me to judge the budgetary aspects since the system is quite different from that which we are used to in The equipment requirements seem reasonable. A charge of $800 for chemical analyses versus only $1,000 for chemicals seems unbalanced. With the current price of chemicals, I would expect a much larger figure than $1,000 and perhaps rather less for chemical analyses.

Recent research achievements of the Principal Investigator(s):

Of relevance to this proposal, studies on the polarization characteristics of the emission and excitation spectra of various bipyridine derivatives are noteworthy. ( )

Recent work Mentioned but Not rated explicitly.

OVERALL RATING: X EXCELLENT ___ VERY GOOD ___ GOOD ___ FAIR ___ POOR

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REVIEWER'S SIGNATURE
REVIEWER'S NAME (TYPED)
OTHER SUGGESTED REVIEWERS (OPTIONAL)

FOUNDATION

PROPOSAL EVALUATION FORM

NSF Form 5

PROPOSAL NO.	INSTITUTION	PLEASE RETURN BY
PRINCIPAL INVESTIGATOR	NSF PROGRAM	
TITLE		

Comments (continue on additional sheet(s) as necessary):
Quality of the proposed research (including budget and institutional capability):

Specifically The prior work but
No rating given.

The PI is a sound investigator with a good track record in the study of transition metal complex spectroscopy, who has also shown a good pace of activity over the past several years. The question of multiple state emissions is a very important one to the photochemical and photophysical properties of metal complexes, one which was largely ignored by investigators in this field until the work of and of who established that this was a valid phenomenon worthy of serious consideration. In this context the proposal represents a worthwhile area of future investigation. The key to this proposal is the polarization experiments. Frankly, I have difficulty extracting the types of conclusions the author does from the polarization spectra that the PI so confidently derives. Examination of the data suggests that the interpretations are not nearly as straightforward as one would like, although my doubts may be the result of my relative inexperience with the technique. Nonetheless, the author's work in this area and others described in the proposal is making a sound contribution to the fundamental understanding of excited state properties of metal complexes and is worthy of future support.

Recent research achievements of the Principal Investigator(s):

OVERALL RATING: ___ EXCELLENT X___ VERY GOOD ___ GOOD ___ FAIR ___ POOR

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REVIEWER'S SIGNATURE	REVIEWER'S NAME (TYPED)
OTHER SUGGESTED REVIEWERS (OPTIONAL)	

PROPOSAL NO.
INSTITUTION
PLEASE RETURN BY
PRINCIPAL INVESTIGATOR
NSF PROGRAM
TITLE

COMMENTS (CONTINUE ON ADDITIONAL SHEET(S) AS NECESSARY)

Four experiments are proposed, called program (a) - (d) [see pp. 5, 6 of the proposal

Program (a) should be feasible but has the experimental problem of differential mass discrimination as a function of repeller voltage.

Program (b) has a similar goal as that of the parent-daughter-grand-daughter studies already in progress in lab. However, it is stated that "the delayed laser will irradicate the ionic fragments individually in the free field flight tube by adjusting the repelling voltage or the delay time between the two lasers." TOF discrimina ions by their arrival times. Dissociation in the field-free region causes essentially no change in arrival time. Therefore, there seems to be reason to doubt the soundness of wha has been proposed, but perhaps this is a misunderstanding on my part of the techniqu proposed.

Program (c) is a continuation of Program (a) and no further comment seems called for.

Program (d) really tests whether two isomers go through a common intermediate at a sufficient degree of excitation, not whether the maximal entropy theory of Silberstein and Levine is correct. I do not consider this one of the more interesting questions in multiphoton ionization, but opinion is sure to differ on this matter.

The previous research record of is truly outstanding and the continued support of his research program including the request for instrumentation is enthusiastica recommended, although the present proposal does not present this work in the best light.

Some prior work

RATING ☐ EXCELLENT ☒ VERY GOOD ☐ GOOD ☐ FAIR ☐ POOR

Verbatim but anonymous copies of reviews will be sent only to the principal investigator/project director. Subject to this NSF policy and applicable laws, including the Freedom of Information Act, 5 USC 552 and formal requests from Chairpersons of Congressional committees having responsibi- ity for NSF, reviewers' comments will be given maximum protection from disclosure.

REVIEWER'S SIGNATURE
REVIEWER'S NAME (TYPED)
OTHER SUGGESTED REVIEWERS (OPTIONAL)

NATIONAL RESEARCH PRIORITIES

This year, for the second time, the Academies of Science, Engineering and the Institute of Medicine have provided a formal briefing document to the President's Science Advisor and NSF on Federal investment opportunities. This report outlines five areas that represent high pay off areas for Federal investment in FY 85. The areas were:

- Selected Areas in Chemistry
- Immunology
- Solid Earth Sciences
- Cognitive Sciences and Artificial Intelligence and
- Computers in Design and Manufacturing

Over the past year I have discussed with NASA and NSF officials the need to increase our national commitment to these last 2 areas and was therefore pleased to see them highlighted by the Academies.

Question: Do you agree with the Academies' assessment of the importance of these 2 areas?

Answer: Yes, Mr. Chairman, I do. In fact, we worked with the OSTP and the Academy to identify the study topics. They are going to be very useful to us as we plan future programs. For example, the research briefing on computers in design and manufacturing has already been an important element in the development of our 1985 initiative in cross-disciplinary centers for research in engineering.

The 92-page report concludes, "Currently, much more support is available to computer science and artificial intelligence than to cognitive science. This imbalance stems directly from their perceived roles as being hard and soft sciences, respectively. Yet it should be clear from this entire report that the two disciplines closely interlock and contribute to each other at every level and on every scientific problem. Cognitive science especially needs resources to permit it to contribute as a full partner."

I see by your budget request that while your overall research budget is proposed to increase by over 14%; the increase proposed for computer research will increase by 16.1%; automation and sensing is up to 30%; while the proposed increase for cognitive scientists is only 5.3%; and information science and technology is up by only 8.2%.

Question: Do you believe the difference in growth rates in these 2 areas represents a subtle bias at the Foundation?

Answer: In the specific program elements for cognitive science and information science, growth is real and is commensurate with the opportunities in the field and the quality and numbers of proposals submitted to the Foundation. In addition, there are important opportunities for cognitive scientists and information scientists in both of the fields which you referenced -- computer research and automation and sensing. These are interdisciplinary areas which require the research skills of a broad range of scientists.

Senator Garn—Continued

Last month we asked you to prepare a chart showing the total NSF resources devoted to supercomputer, artificial intelligence, robotics, cognitive science etc.

Question: Could you please provide this information for the record?

NSF Obligations for Research in Selected Areas[1/]
FY 1984 - 1985
(Dollars in Millions)

Directorate	Est. FY 1984	Est. FY 1985
Astronomical, Atmospheric, Earth and Ocean Sciences	-0-	-0-
Biological, Behavioral, and Social Sciences	$ 7.8	$ 8.1
Engineering	6.5	7.0
Mathematical and Physical Sciences	21.0	25.0
Scientific, Technological, and International Affairs	2.3	3.7
TOTAL	$37.6	$43.8

[1/] Robotics, Artificial Intelligence, Research on Supercomputers, Remote Artificial Sensing, Expert Systems, Telepresence/Prosthetics, Cognitive/Memory Sciences.

- For BBS most of the obligations are in the Division of Information Science and Technology and the Division of Behavioral and Neural Sciences. Topics covered are robotics, artificial intelligence, expert systems, and cognitive/memory sciences.
- The Divisions of Electrical, Computer and Systems Engineering and Mechanical Engineering and Applied Mechanics account for nearly all the estimated support. All areas except cognitive/memory sciences are included. About 66% of the 1984 dollars and 73% of the 1985 dollars are for robotics research.
- In MPS most of the support is for artificial intelligence and research underlying development of future computers. In fact, about 75% is for the latter. Although the direct dollar levels in mathematics and materials research are quite low, basic research in both these areas contributes significantly to the development and application of technologies and systems and development of advanced electronic materials. These tend to be work of indirect immediate applicability, but which does provide a basis for direct research on the subject topics.

- The major portion of the STIA support is in the Division of Industrial Science and Technological Innovation, complemented by funds for policy research related to the subject fields.

Question: Could you please describe the situation in the academic research community that led the Foundation to initiate this program?

Answer: Prior to 1970 the Federal government encouraged/supported growth in university computing. In the 1970's, Federal support slackened, university facilities declined and fell behind their industrial counterparts. In addition, as the cost of minicomputers plunged and their power increased significantly, grant funds that might have been used to support university central computer facilities were invested in the new generation of minicomputers.

Supercomputers were first introduced in national laboratories. As a result, these computers only were generally accessible to only two university researcher groups -- atmospheric sciences and those studying fusion energy sciences. This has lead to a directing of research away from areas which demand advanced computers, resulting in many opportunities unexplored and a lack of training opportunities for graduate students.

Recently, three supercomputers have been installed at universities but these universities have encountered significant problems. As a result, university systems are underconfigurated relative to the National Labs and these systems are expensive for users. The result is underutilization. Some researchers have gone abroad to use supercomputers, which are readily accessible to university scientists.

There is a need for NSF to aggregate the users that need access to supercomputers since the requirements of individual disciplines or campuses are generally not sufficient to justify a supercomputer.

Networking is important to access computers and to improve interactions and enhance productivity of research. We are planning to take significant steps in 1985 to provide improved networking and access to the most advanced scientific computers.

On February 8, I wrote to you approving the required reprogramming to get started on this program in FY 84. I also raised 2 issues relative to the future management of the program.

First, I suggest that NSF establish a formal user evaluation process so that each computer Center knows exactly where it is not meeting the needs of the user community. Furthermore, such evaluation should be a key factor in determining if a Center should continue to receive NSF funding. I want to make sure that we are not going to establish an entitlement program.

Question: Could you please comment on the issue of user evaluation?

Answer: We believe that this is extremely important. We are currently developing for discussion with our Advisory Committee for Advanced Scientific Computing a list of characteristics which supercomputer centers should exhibit. A system for obtaining user input will be one of the important features of this "model". At a minimum, centers will have user committees such as those that exist at most national user facilities.

We expect specific recommendations from the Advisory Committee at its next meeting on how these user committees can be organized most effectively.

The second issue that I raised has to do with the problem of assuring that the Centers are appropriately motivated to upgrade their facilities. Obviously, we are trying in this program to provide researchers access to the most advanced computer facilities and given the rate of change in the computer field this is a continuing process.

Question: What specific strategy does the Foundation intend to follow to make sure these Centers have sufficient funds to update their facilities?

Answer: If a center does not stay at the forefront of technology, it will cease to have the research impact that we desire. We will be developing a specific strategy on how to do this and will be working closely with our Advisory Committee.

A draft long range plan will be presented to the Advisory Committee at its June meeting. We would certainly discuss this draft with your staff in May, but we will have a much more definitive plan after the June meeting.

Question: What are the other significant management issues you expect to encounter in this program?

Answer: The issues include:

- Coordination with other agencies, particularly in the area of networking.
- Coordination with and awareness of, industrial concerns, particularly with regard to new developments in hardware and software.
- Extent to which technical demonstrations of new hardware and software could be a part of the supercomputer centers program.
- Software productivity.

Question: What proportion of the FY 85 funds would you expect to be devoted to software development?

Answer: None has been specifically identified at this point, but some of the networking support may result in new software and it is likely that some specialized software packages will be developed at the NSF supported centers.

In addition, funding for software development through the disciplinary directorates is expected to be stimulated by the presence of supercomputer centers.

SUPERCOMPUTER TECHNOLOGY AND MARKETING

In your budget justification you describe an NSF funded study that was conducted at Yale University that examined the experience of major industrial countries in supporting high technology industries. The study found that the success of government efforts depends on a willingness to leave technology and marketing decisions to industrial firms. You state in your justification that the findings of this study "are important to clarify the question arising on the debate about U.S. government policies for encouraging development of high technology sectors."

Question: What implications does this study have for defining the appropriate role of the Federal Government in the development of the next generation of supercomputers?

Answer: The study by Professor Nelson is only one of a number funded by the Division of Policy Research and Analysis to obtain insights into the influences of Government policy actions on technological developments. It provides only one perspective about these influences.

Professor Nelson's study does not explicitly address the appropriate role of the Federal Government in the development of the next generation of supercomputers. This study suggests some general principles about policies in support of high technology industries. The Government should:

- support generic research performed by industry;
- encourage (though not direct) industry initiated cooperative research endeavors, perhaps with matching funds;
- avoid making specific technology choices or detailed commercial judgments.

But the case of supercomputers is a special one, perceived as it is as intertangled with national security issues. It is therefore difficult to use the principles given above as prescriptions for policies for supercomputers.

Senator Garn—Continued

SUBCOMMITTEE ANTARCTIC FIELD INSPECTION

As you know two members of the Subcommittee spent three days last year in the Antarctic. As a result of that trip I would like to make several suggestions that might improve the safety and increase the educational benefits for the next set of visitors.

Question: Could you please respond, for the record, to each of these suggestions:

- A survival checklist should be given to each participant indicating what should be in the survival kit and what should be in the carry-on luggage.
- A briefing concerning survival in the Antarctic should be given on the plane trip to New Zealand or at Christ Church.
- A short briefing should be given on the escape procedure from the LC-130's.
- A more detailed science and geography briefing should be given before arrival in the Antarctic.
- A map of McMurdo, identifying each of the buildings by number and function should be made available to each visitor.

Answer:

Survival Checklist

It is in the personnel manual issued to all participants. Additional copies will be made for distribution to individuals.

Briefings on Survival

Survival (and other briefings) are usually scheduled for visitors. This year's visit by Subcommittee members was compressed into such a short time that most briefings had to be cancelled. The booklet "Survival in the Antarctic" is being updated and will form the nucleus of future survival briefings - preferably at Christchurch.

Short Briefing on Escape Procedure from LC-130's.

This is supposed to be standard procedure. The VXE-6 squadron will be directed to ensure such a briefing to all visitor groups.

Science and Geography Briefings

More detailed briefings will depend on the time available in the visitors schedule. Briefings can be tailored to meet visitors schedule and desires.

A Map of McMurdo Identifying Buildings.

Maps will be made available to visitors.

ANTARCTIC FACILITIES

When we were in the Antarctic we saw the construction activities underway on the new water desalination plant at McMurdo.

Question: Is that project still on schedule and within budget? What is the scheduled date for completion?

Answer: The original schedule had to be revised and construction delayed for several years because of major cost increases in other areas, primarily aviation and heating fuel. The project is within budget, and completion is scheduled for December 1985.

In our conversation with the Navy, they raised the possibility that McMurdo could be relocated to provide a more efficient operation.

Question: Do you see any benefits associated with such a relocation? Have you performed a cost benefit analysis of moving McMurdo and identified alternate locations that should be considered?

Answer: There are potential benefits such as enhanced year round air operations, but relocation would require major capital investments.

Marble Point, the major candidate relocation site, is situated on the mainland of Victoria Land about 48 miles northwest of McMurdo Station across McMurdo Sound. It is one of the very few sites with an exposed earth area with suitable topography for a conventional year-round airfield plus the opportunity for ship delivery of bulk fuel. The question of determining the feasibility and cost estimates of construction of a conventional airfield and support facility has been addresed several times since 1957.

Three principal feasibility and cost studies were undertaken by the U.S. Navy of the National Science Foundation using the services of various contractors. The findings are summarized in the following table. All three studies concluded that the construction of a hard surface conventional year-round airfield with associated facilities and seaport at Marble Point would be feasible but would require a large capital expenditure and a major multi-year construction effort.

Year Of Study	By	Period of Construc.	Total Cost	Cost Projected to 1985 at 6% p.a.	Remarks
1959	Naval Construction Unit Metcalf & Eddy, Inc.	10 years	$174M	$ 746M	1. Included utilities (Nuclear power plant), Fuel Storage Tanks, 2 Hangars, wharf, etc.

Senator Garn—Continued

Year Of Study	By	Period of Construc.	Total Cost	Cost Projected to 1985 at 6% p.a.	Remarks
1970	NSF Study for Bechtel, Inc.	4 years	$ 173M	$ 404M	1. Included facilities equivalent to those of McMurdo
1978	NSF Contractor Holmes & Narver Inc.	6 years	$ 304M	$ 450M	1. It was estimated that the cost would be reduced by $185M (1978) by using fresh water ice fill instead of blasted earth and rock fill. 2. Included McMurdo-type facilities plus limited port facilities.

A review of these studies shows that icebreakers would continue to be required. At the location of the port facility there is normally several miles of ice that tends to break out naturally for a period, at best, of 3 to 4 weeks in February. But even then, ice-strengthened cargo ships should not rely on ice free passage through the Ross Sea and the northern approaches to McMurdo Sound as well as freedom from interference by pack ice at the Marble Point site or bergs in the area. Moreover, during the years of construction, icebreakers would be needed early each season to assist the off-load of construction cargo in order to make maximum use of each summer season. It is concluded that with the addition of a new facility at Marble Point, the requirement for icebreaker support would be no less than it is at present.

The rationale for substituting a single new facility at Marble Point for three or four existing facilities is weakened by several points. First, the existing inventory of LC-130 ski-equipped aircraft would continue to be used as a vital component of effective U.S. presence because they enable such flexible and extensive access to various areas of the Continent. The ski C-130s would continue to support South Pole Station and would continue to require a "white out" or alternate landing area on the ice shelf near McMurdo. Second, the facilities at Christchurch would continue to serve valid requirements for aircraft servicing and maintenance. Although the advent of hangars and facilities at Marble Point would allow scheduling of phase maintenance of LC-130s there, it can readily be visualized that the amount of air traffic to Antarctica staging out of New Zealand would generate unscheduled maintenance activity in volumes that would preclude elimination of the small facility now in use at

Christchurch. It is also considered that a sea ice runway might continue to be set up early season near McMurdo in order to provide an alternate and contingency landing site where otherwise the wheeled aircraft would be obliged to plan payloads so as to use runways in New Zealand as the alternate. Finally, the vision of using a Marble Point facility is a mode that enjoys the economy of zero expense for the facility at McMurdo tends to break down. The upgraded facilities, the fuel storage system, the modern power and water plants at McMurdo would simply not be abandoned to a totally inactive status.

If it is desirable from a policy viewpoint to build a Marble Point airfield to enhance the U.S. presence in Antarctica, our air operations would indeed be improved. However, it is not a cost-effective option. The annual interest on the $0.5 billion investment would exceed the present annual cost of air operations and the associated facilities in Antarctica.

Alternate locations that have been considered are:

Pine Island Bay 102°W-74°S

There is a possibility that a group of small rocky islets here could be consolidated into a year-round hard surface runway. Aerial and ground surveys were made of this area in 1975. As a result of these it appears that the construction costs for such a runway would be extremely high. The base would be more remote than McMurdo from several of the main areas of United States scientific interest: South Pole, Dry Valleys. Moreover, heavy pack ice to seaward of the Bay makes ship access very difficult at best and at many times hazardous or impossible.

Antarctic Pensinsula Area

An extensive site survey was conducted here in 1963. The main purpose was to choose a location for Palmer Station. However, at the same time consideration was given to possible sites for year-round aircraft operations. The areas on Seymour Island and King George Island have since been used by other nations for the purpose. However, the Peninsula area is remote from the main part of the Antarctic continent; and there was not enough scientific interest in the local peninsula area to justify the expense necessary to make an adequate airfield for wheeled aircraft.

Question: Moving on to the South Pole Station -- could you describe the useful life expectancy of that station? Have you done any cost engineering studies to explore the feasibility of jacking-up the dome vs. replacing it?

Answer: In the 1982-83 operating season a survey was made of the geodesic dome at the South Pole Station to ascertain its actual condition. The survey report indicated that there is no evidence of failure in the dome structure, although there is some damage to the tension (base) ring at the entry area and some unevenness in the settlement of the tension ring. From that study it appears that the dome would have fair life expectancy if the excess drift snow around it could be removed, thus lessening weight on the dome and one the snow base itself. Another idea and one that might be used in conjunction with snow removal would be the insertion of wind spoilers or deflectors on or around the dome to try to force the wind to scour the dome clean. Jacking up the dome could be feasible. However, the snow accumulation would still have to be removed first to prevent damage to the dome.

The dome is only one aspect of South Pole Station that is aging and requiring increasing amounts of attention. In recent years good progress has been made on performing maintenance with the funds allocated to South Pole. Over the next few years larger projects will be considered to extend the life of the existing station vice building a new station. During the 1984-85 season a D-8 (bulldozer) will be sent to South Pole to begin removing snow from around the station. If the efforts to control snow accumulation prove successful, attempts will be made to remove additional quantities of snow that has accumulated over the years and caused the dome to settle unevenly. If sufficient snow can be removed, it may not be necessary to repair or replace the dome. In any case, if the dome cannot be striped of its overburden of snow, jacking will not be feasible.

The buildings, equipment, and life support systems within the dome will certainly need either extensive renovation or replacement. Depending on the future requirements for work at South Pole, it may actually be necessary to construct a new Station. This might be on the design of the permanent early warning stations in Greenland, a replacement facility within the existing dome or some different and new conception. It is likely that the dome itself will be useful for many years, even if only for a storage and fuel supply area. Design studies for a replacement station have been underway for some time.

Question: What benefits, if any, would result from the construction of a permanent ice runway at McMurdo and South Pole Stations?

Answer: We are generally not supportive of the idea of building a compacted snow runway at McMurdo. The reason is that the old glacier ice runway at outer Williams Field (14 miles from McMurdo) would be safer than a compacted snow runway. We are more supportive of the idea of a snow compacted runway at South Pole Station because there is relatively little snowfall and the temperatures would permit easier maintenance in the summer seasons.

An experienced engineer estimates the construction cost of such a runway at South Pole Station to be in excess of five million dollars. We certainly would wish to maintain ski-equipped aircraft in the U.S. Antarctic Program to permit us to operate through the continent. With these ski-equipped LC-130 aircraft the annual resupply of the Station takes about 550 flight hours. Therefore the construction of the runway there for wheeled aircraft does not seem cost effective. However, a small amount of research is now contemplated in order to update previous estimates in the light of any new technology that might be available.

INTERNATIONAL ACTIVITIES WITH AUSTRALIA

In the past NSF has, through its grant program, offered scientists the opportunity to work together with their foreign colleagues in order to take full advantage of non U.S. research facilities.

In December Senator Leahy and I spent several days in Australia discussing international banking and scientific issues. One of the points raised by the representatives of the Australian government was the need to increase international scientific activities with the United States. Australia, being a rather small country in terms of population, views these scientific programs as essential for the development of its scientific and technological base.

In fact, during my discussion with members of the Australian government they specifically indicated their interest in developing high technology research parks similar to those found in Salt Lake City and other areas across the country.

I notice in your justification, as an example of fruitful scientific interchange, you note a joint U.S. Australian study which made use of the Australian Atomic Energy Agency's Neutron Reactor. You further note that "Australian expertise and special equipment for neutron radiology are rarely matched anywhere in the world".

Question: To what extent does the Foundation intend to support additional research activities with Australian in this and other science and technology areas during FY 85?

Answer: Despite its small population (about one-third of one percent of the world total), Australia is estimated to produce about two percent of the world's annual basic scientific "output". A combination of factors--strength in basic research, the lack of cultural, linguistic and political barriers, plus a distance and cost of travel that make it difficult for U.S. scientists to cooperate with Australian colleagues without supplemental support--have helped NSF's U.S.-Australia Cooperative Science Program grow into a relatively large one compared to other countries of similar size. U.S. scientists are attracted to work in Australia's unique environment--its flora and fauna, geology, surrounding oceans, climate and southern hemispheric vantage point--and with its highly competent scientists, ~~who~~ have often been trained in the U.S. or the U.K., in laboratories that are, by and large, the equal in quality of their counterparts in the U.S., Japan, and Western Europe.

Because of these circumstances, NSF thus maintains a healthy and very important program of cooperation, involving at least 100 U.S. scientists a year. The Division of International Programs (INT) contributes approximately $100,000 in funds for joint seminars and workshops and for research development (short-term visits), and around $200,000 in cooperative research funds jointly managed with other NSF divisions. The INT funds normally precipitate three to four times as much in contributions from the disciplinary directorates for jointly managed projects; these directorates also manage directly projects involving Australia in the ocean and atmospheric sciences and in Antarctica.

In addition to this ongoing program of cooperation, we have, over the past year, explored with our Australian counterparts the idea of establishing emphasis areas in which both sides believe the potential benefit to be particularly strong. Thus, INT is working with the Division of Materials Research (DMR) to define areas where additional opportunities and resources might be made available to U.S. scientists for work with Australian colleagues. We have had discussions with Australian scientists and government officials concerning the Ocean Drilling program, and there is a possibility that Australia will become a participant in this effort. With the Division of Physiological, Cellular and Molecular Biology (PCM), INT is also organizing a joint advisory workshop for spring 1985 in Canberra which will bring together the best U.S. and Australian workers in the field of plant molecular biology to define for NSF and the Australian Government a program of cooperative research over the next five to ten years designed to speed advances in biotechnology with application to agriculture. Moreover, since becoming Director, I have met with several high-level Australian visitors at NSF, including the Minister for Science and Technology, the Deputy Secretary of the Department of Science and Technology, the Australian Science Advisor and one of the Executive Members of CSIRO, to discuss the potential for enhanced cooperation.

Through such interactions and exchanges, the Foundation keeps abreast of Australia's scientific strengths, weaknesses and needs. We have offered advice to the Australians on setting up their new "centers of excellence" program, on improving their S&T statistical and data analysis capabilities, on building new facilities, such as the Australia Telescope and an oceanographic research vesels, and on strengthening their cooperative science relations with other nations, including Japan, Mexico and West Germany.

I believe that a strong science and technology infrastructure in Australia is beneficial to the United States. NSF will continue to seek opportunities to expand and improve our cooperative relationship within the resources available in order to assure continuing access for U.S. scientists to Australia's unique environment, facilities and expertise. In return, we will continue to respond with our best efforts to the needs they express and to guarantee access for Australian scientists to U.S. facilities, especially in such areas as high-energy physics, where Australia's resources are insufficient to allow independent efforts.

MANAGEMENT INFORMATION SYSTEMS

Our FY 84 report cites the need for the Foundation to assume a more active role in setting science policy. The report compliments you, Dr. Knapp, for you active interest in these issues of science policy but goes on to state.

"One of the impediments to the Foundation adopting a more expansive role is the longstanding lack of analytic capability and a Management Information System in the Administrative Office of the Foundation. The Committee urged the Director to correct this situation as soon as possible.

Your FY 85 budget contains an increase of $1,050,000 for data processing equipment. I understand this will be used to add an additional 330 work stations and provide increased information processing capability for the Foundation.

Question: Where do you stand on the implementation of your long range ADP plan?

Answer: The major FY 84 milestone of the Long Range Plan - the termination of the NSF Honeywell System at the end of this fiscal year -- is on schedule. Cuts in staffing and budget have delayed the implementation of the mission-oriented systems such as the Financial Management, Proposal and Reviewer Systems and have caused delays in acquiring workstations. However, if no further slippages in delivery schedules occur, it is expected that the transition from the Honeywell to the mini/micro environment will be accomplished by September 30, 1984.

FY 85 funds will be used to complete the acquisition of multifunctional workstations for the new NSF distributed information processing environment. Associated data communications hardware will also be purchased. The installation of this final increment of equipment will ensure that the NSF staff has access to state-of-the-art computing tools, and is a crucial item in our modernization effort.

Question: Could you please provide a listing of the major milestones in your plan for the record?

LONG RANGE PLAN MAJOR MILESTONES

Milestones Accomplished

Sep. 82	Completed User Requirements Analysis for Major NSF Systems
Feb. 83	Implemented Prototype Systems in Engineering Directorate
July 83	MIS Steering Committee elected to expand prototype
Aug. 83	Completed selection and initial procurement of IBM microcomputers
Dec. 83	Installed prototype in second Directorate (MPS)
Feb. 84	Initiated user acceptance testing of Administrative Systems

Future Plans

May 84	Prototype test of microcomputer network
July 84	All major systems operating in mini/micro environment and implemented in all Directorates
Oct. 84	Retire Honeywell 6060N
FY 85	Develop a Decision Support System for NSF management

As a specific indication of my concerns, I asked the Foundation on October 1, 1983, for the number of grants awarded in FY 1983. You were not able to provide that information until January 26, 1984,--or 16 weeks later. This kind of delay makes it very difficult for you to manage and for us to conduct our oversight.

Question: Could you please keep us up-to-date on the status of the development of your Management Information System?

Answer: Yes, we will keep you up-to-date on the status of this development.

Question: Could you please provide for the record, a table listing the specific data elements in each of the standard reports that the Management Information System will generate and the frequency of the reports?

Answer: The attached matrices list standard MIS reports and the types of data and/or data elements found in each. Many reports are produced on a regular basis (i.e., quarterly or more frequently), but most batch reports (and all on-line reports) are produced as required. These matrices represent a summary of approximately 200 pages of detail that can be provided if desired.

CROSS REFERENCE MATRIX OF
RESOURCES AND DATA TYPES

	AWARD INFORMATION (BATCH)	Active Awards by Division	Active Awards by State and Institution	Notification of Awards (In-House)	Overdue FPR's by PI	Qtly Rept. Awds. by State (Governor's Rept.)	AWARD INFORMATION (ON-LINE)	Award Information Report - AT2	Daily Award Display - PT1	AWARD INFORMATION (OFFICE - BATCH)	Summary Report of Institutions by Org. PS4	Active Awards by Org - AW1	Active Awards by Org/Inst - AW2	Active Awards by State/Congr Dist - AW3	Active Awds by Expir. Date/Fiscal Rpt Flag-AW4	Chart of $ Amt for Data Elem (Org/Disp) - OT1	AWARD INFORMATION (OFFICE - ON-LINE)	Single Award Info Available On-Line - ON2	FINANCIAL INFORMATION (BATCH)	Budget Exec. Plan Det'l within Org.	Budget Exec. Plan Sum'y by Appr.	Budget Exec. Plan Sum'y Dir/Prog.	Budget Exec. Plan Sum'y by Prog.	Budget Exec. Plan Sum'y by Org.	FINANCIAL INFORMATION (ON-LINE)	Budget & Accounting Code Verif. - PA5	Budget Execution Plan Report - FM1	Program Act. (Report for Single PE) - FM3	INST'L TECHNICAL REFERENCE FILE INFO - (BATCH)	ITRF Complete Listing	MANAGEMENT STATISTICAL INFO (BATCH)	Props Rcvd/Tot Act (MGTSTAT1A-B/27A-B)
Action Date	1						1			1							1		1						1				1		1	
Actions Statistics	2						2			2							2		2						2				2		2	■
Amendment Data	3	■	■				3	■		3		■	■	■	■		3		3						3				3		3	
Amt Prop'd-Declines/Withdrwls	4						4			4							4		4						4				4		4	■
Appropriation	5						5			5							5		5	■	■	■	■	■	5	■	■	■	5		5	
Available Balance	6						6		■	6							6		6	■	■	■	■	■	6				6		6	
Award Amount	7	■	■	■		■	7	■	■	7	■	■	■	■	■		7	■	7						7				7		7	■
Award Date	8	■	■				8	■		8		■	■	■	■		8	■	8						8				8		8	
Award Duration	9	■	■	■		■	9	■		9		■	■	■	■		9	■	9						9				9		9	
Award Number	10	■	■	■	■	■	10	■	■	10		■	■	■	■		10	■	10						10				10		10	
Award Data - Other	11	■	■	■	■		11	■	■	11		■	■	■	■		11		11						11				11		11	■
Budget Data	12						12			12							12		12	■	■	■	■	■	12	■	■		12		12	
Category of Request/Award	13						13			13						■	13	■	13						13				13		13	
CO-PI Name	14						14			14							14		14						14				14		14	

CROSS REFERENCE MATRIX OF
RESOURCES AND DATA TYPES

	Commitment Data	Congressional District	Continuing Grant-Year & Amount	Country Data	Date Proposal Received	Date Reviewer Last Changes/Used	Directorate Name	Disposition Date	Fle of Application/Sci Cd (FOA/FOS)	Fiscal Year Data	Foreign Country Name	Future Commitment Amount/Year	Grantee or Contractor Name	Institution Address
AWARD INFORMATION (BATCH)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Active Awards by Division									■					
Active Awards by State and Institution									■					
Notification of Awards (In-House)		■												
Overdue FPR's by PI														
Qtly Rept. Awds. by State (Governor's Rept.)				■										
AWARD INFORMATION (ON-LINE)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Award Information Report - AT2			■	■					■	■				
Daily Award Display - PT1														
AWARD INFORMATION (OFFICE - BATCH)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Summary Report of Institutions by Org. PS4														
Active Awards by Org - AW1														
Active Awards by Org/Inst - AW2														
Active Awards by State/Congr Dist - AW3		■												
Active Awds by Expir. Date/Fiscal Rpt Flag-AW4										■				
Chart of $ Amt for Data Elem (Org/Disp) - OT1					■			■	■					
AWARD INFORMATION (OFFICE - ON-LINE)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Single Award Info Available On-Line - ON2		■		■					■		■			
FINANCIAL INFORMATION (BATCH)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Budget Exec. Plan Det'l within Org.	■													
Budget Exec. Plan Sum'y by Appr.	■													
Budget Exec. Plan Sum'y Dir/Prog.	■						■							
Budget Exec. Plan Sum'y by Prog.	■													
Budget Exec. Plan Sum'y by Org.	■													
FINANCIAL INFORMATION (ON-LINE)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Budget & Accounting Code Verif. - FA5							■			■				
Budget Execution Plan Report - FM1	■									■				
Program Act. (Report for Single PE) - FM3	■									■				
INST"L TECHNICAL REFERENCE FILE INFO - (BATCH)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
ITRF Complete Listing		■												■
MANAGEMENT STATISTICAL INFO (BATCH)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Props Rcvd/Tot Act (MGTSTAT1A-B/27A-B)							■			■				

Senator Garn—Continued

Proposal Actions/Pending	Proposals Age in Months	Proposal/Award Number	Proposal Amount	Program Name/Reference Code	Program Element Code	PI/PD Data	Other Financial Systems Data	Organization Code	Operating Plan Code	Obligations	Object Class Code	Institution Name and Data	Institution Code	CROSS REFERENCE MATRIX OF RESOURCES AND DATA TYPES
42	41	40	39	38	37	36	35	34	33	32	31	30	29	AWARD INFORMATION (BATCH)
					■	■		■			■	■		Active Awards by Division
					■	■		■			■	■		Active Awards by State and Institution
						■		■				■		Notification of Awards (In-House)
						■						■		Overdue FPR's by PI
			■			■						■		Qtly Rept. Awds. by State (Governor's Rept.)
42	41	40	39	38	37	36	35	34	33	32	31	30	29	AWARD INFORMATION (ON-LINE)
					■	■		■			■	■	■	Award Information Report - AT2
			■					■						Daily Award Display - PT1
42	41	40	39	38	37	36	35	34	33	32	31	30	29	AWARD INFORMATION (OFFICE - BATCH)
			■					■				■		Summary Report of Institutions by Org. PS4
					■	■		■			■	■		Active Awards by Org - AW1
					■	■		■			■	■		Active Awards by Org/Inst - AW2
					■	■		■			■	■		Active Awards by State/Congr Dist - AW3
					■	■		■			■	■		Active Awds by Expir. Date/Fiscal Rpt Flag-AW4
				■	■			■			■	■	■	Chart of $ Amt for Data Elem (Org/Disp) - OT1
42	41	40	39	38	37	36	35	34	33	32	31	30	29	AWARD INFORMATION (OFFICE - ON-LINE)
		■		■		■		■				■	■	Single Award Info Available On-Line - ON2
42	41	40	39	38	37	36	35	34	33	32	31	30	29	FINANCIAL INFORMATION (BATCH)
					■		■	■	■	■	■			Budget Exec. Plan Det'l within Org.
							■			■				Budget Exec. Plan Sum'y by Appr.
					■		■	■		■				Budget Exec. Plan Sum'y Dir/Prog.
					■		■	■		■				Budget Exec. Plan Sum'y by Prog.
					■		■	■		■				Budget Exec. Plan Sum'y by Org.
42	41	40	39	38	37	36	35	34	33	32	31	30	29	FINANCIAL INFORMATION (ON-LINE)
					■			■	■					Budget & Accounting Code Verif. - FA5
				■	■			■	■	■				Budget Execution Plan Report - FM1
					■			■		■				Program Act. (Report for Single PE) - FM3
42	41	40	39	38	37	36	35	34	33	32	31	30	29	INST"L TECHNICAL REFERENCE FILE INFO - (BATCH)
												■	■	ITRF Complete Listing
42	41	40	39	38	37	36	35	34	33	32	31	30	29	MANAGEMENT STATISTICAL INFO (BATCH)
								■				■		Props Rcvd/Tot Act (MGTSTAT1A-B/27A-B)

Senator Garn—Continued

CROSS REFERENCE MATRIX OF RESOURCES AND DATA TYPES	Proposals Received/Reserved	Other Proposal Data	Proposal Statistics	Recommend Data	Registry Number	Requested Duration	Reviewer Data	Special Data Fields	Split Data	State Abbreviation	Sub-Appropriation	Summary Awards Data	Total Program Activity	Type of Request/Award Code
AWARD INFORMATION (BATCH)	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Active Awards by Division									●					
Active Awards by State and Institution									●					
Notification of Awards (In-House)										●				
Overdue FPR's by PI														
Qtly Rept. Awds. by State (Governor's Rept.)		●	●							●				
AWARD INFORMATION (ON-LINE)	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Award Information Report - AT2									●					●
Daily Award Display - PT1		●			●				●					
AWARD INFORMATION (OFFICE - BATCH)	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Summary Report of Institutions by Org. PS4		●							●					
Active Awards by Org - AW1									●					●
Active Awards by Org/Inst - AW2									●					●
Active Awards by State/Congr Dist - AW3									●	●				●
Active Awds by Expir. Date/Fiscal Rpt Flag-AW4									●					●
Chart of $ Amt for Data Elem (Org/Disp) - OT1		●		●		●		●		●				
AWARD INFORMATION (OFFICE - ON-LINE)	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Single Award Info Available On-Line - ON2														●
FINANCIAL INFORMATION (BATCH)	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Budget Exec. Plan Det'l within Org.					●						●	●		
Budget Exec. Plan Sum'y by Appr.														
Budget Exec. Plan Sum'y Dir/Prog.														
Budget Exec. Plan Sum'y by Prog.											●	●		
Budget Exec. Plan Sum'y by Org.											●	●		
FINANCIAL INFORMATION (ON-LINE)	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Budget & Accounting Code Verif. - FA5											●			
Budget Execution Plan Report - FM1				●										
Program Act. (Report for Single PE) - FM3				●									●	●
INST'L TECHNICAL REFERENCE FILE INFO - (BATCH)	43	44	45	46	47	48	49	50	51	52	53	54	55	56
ITRF Complete Listing										●				
MANAGEMENT STATISTICAL INFO (BATCH)	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Props Rcvd/Tot Act (NCSTATIA-B/27A-B)	●	●								●			●	

Senator Garn—Continued

CROSS REFERENCE MATRIX OF
RESOURCES AND DATA TYPES

	PROPOSAL INFORMATION (BATCH)	Proposals/Awards by Principal Field of Science	Cumulative Actions by State/Cong. Dist.	Cumulative All Actions (FOA)	Cumulative All Actions (FOS)	Cumulative All Awards (FOA)	Cumul List Awards State/Cong Dist	Cumul. List. Awards Int'l Impl.	Daily List of Proposals Received	Daily List of Proposals Recommended	Detailed List. Actions 9-12 / over 12 mos.	Fiscal Year Grants & Contracts (TABA)	Props. Rcvd/Actions Taken by State/Inst.	PAIS Verification of All Actions	Pending Props. by Org. (9-12 / over 12 mos.)	Proposal Evaluation Form	Workload Stat. Rept. - Fiscal Year Awards only	Workload Stat. Rept. - FY Props Actions	Props. Rcvd/ Actions (NSB Stats) Summary	Props. Rcvd/ Actions (NSB Statistics)	Recom'd. Props - Funds Reserved by Org.	Report of Award Actions (NSB Rept.)	Summary of Actions (Monthly & Cumulative)	PROPOSAL INFORMATION (ON-LINE)	Financial Split Record Display - PS2	Proposal & Application Info. Sys. - PU3	Recomm., Resvtion, Awd. Data by PE - PF9	Active Proposal Histogram - PB4	Proposal by User - Selected Criteria - PA9	Proposal Information Report - PE8	Proposal With Int'l Implication - PC1	Special Program Data Fields - PA1
Action Data	1	■	■	■	■	■							■		■		■	■						1								
Actions Statistics	2	■																	■	■				2								
Amendment Data	3	■	■	■	■	■					■													3								
Amt Prop'd-Declines/Withdrwls	4																■		■	■				4								
Appropriation	5																							5								
Available Balance	6																							6								
Award Amount	7	■			■	■	■	■											■	■		■		7	■	■	■					
Award Date	8												■					■						8	■	■						
Award Duration	9									■	■						■	■				■		9		■	■					
Award Number	10																							10	■	■						
Award Data - Other	11										■						■	■						11						■		
Budget Data	12																							12								
Category of Request/Award	13																							13		■				■		
CO-PI Name	14																							14		■				■		

Senator Garn—Continued

CROSS REFERENCE MATRIX OF
RESOURCES AND DATA TYPES

	PROPOSAL INFORMATION (BATCH)	Proposals/Awards by Principal Field of Science	Cumulative Actions by State/Cong. Dist.	Cumulative All Actions (POA)	Cumulative All Actions (POS)	Cumulative All Awards (POA)	Cumul List Awards State/Cong Dist	Cumul. List. Awards Int'l Impl.	Daily List of Proposals Received	Daily List of Proposals Recommended	Detailed List. Actions 9-12 / over 12 mos.	Fiscal Year Grants & Contracts (TABA)	Props. Rcvd/Actions Taken by State/Inst.	PAIS Verification of All Actions	Pending Props. by Org. (9-12 / over 12 mos.)	Proposal Evaluation Form	Workload Stat. Rept. - Fiscal Year Awards only	Workload Stat. Rept. - FY Props Actions	Props. Rcvd/ Actions (NSB Stats) Summary	Props. Rcvd/ Actions (NSB Statistics)	Recom'd. Props - Funds Reserved by Org.	Report of Award Actions (NSB Rept.)	Summary of Actions (Monthly & Cumulative)	PROPOSAL INFORMATION (ON-LINE)	Financial Split Record Display - PS2	Proposal & Application Info. Sys. - PU3	Recomm., Resvtion, Awd. Data by PE - PP9	Active Proposal Histogram - PB4	Proposal by User - Selected Criteria - PA9	Proposal Information Report - PE8	Proposal With Int'l Implication - PC1	Special Program Data Fields - PA1
Commitment Data	15																							15	■							
Congressional District	16						■																	16								
Continuing Grant-Year & Amount	17																							17								
Country Data	18							■	■															18							■	
Date Proposal Received	19	■	■	■	■	■	■		■		■			■	■		■	■			■			19		■				■		
Date Reviewer Last Changes/Used	20																							20								
Directorate Name	21											■							■	■			■	21								
Disposition Data	22													■										22		■	■		■	■	■	
Fld of Application/Sci Cd (POA/POS)	23	■	■	■		■	■				■			■	■		■	■			■			23		■				■		
Fiscal Year Data	24				■							■												24	■							
Foreign Country Name	25								■															25							■	
Future Commitment Amount/Year	26																							26						■		
Grantee or Contractor Name	27											■												27								
Institution Address	28								■															28								

Senator Garn—Continued

CROSS REFERENCE MATRIX OF RESOURCES AND DATA TYPES

	PROPOSAL INFORMATION (BATCH)	Proposals/Awards by Principal Field of Science	Cumulative Actions by State/Cong. Dist.	Cumulative All Actions (FOA)	Cumulative All Actions (FOS)	Cumulative All Awards (FOA)	Cumul List Awards State/Cong Dist	Cumul. List. Awards Int'l Impl.	Daily List of Proposals Received	Daily List of Proposals Recommended	Detailed List. Actions 9-12 / over 12 mos.	Fiscal Year Grants & Contracts (TABA)	Props. Rcvd/Actions Taken by State/Inst.	PAIS Verification of All Actions	Pending Props. by Org. (9-12 / over 12 mos.)	Proposal Evaluation Form	Workload Stat. Rept. - Fiscal Year Awards only	Workload Stat. Rept. - FY Props Actions	Props. Rcvd/ Actions (NSB Stats) Summary	Props. Rcvd/ Actions (NSB Statistics)	Recom'd. Props - Funds Reserved by Org.	Report of Award Actions (NSB Rept.)	Summary of Actions (Monthly & Cumulative)	PROPOSAL INFORMATION (ON-LINE)	Financial Split Record Display - PS2	Proposal & Application Info. Sys. - PU3	Recomm., Resvtion, Awd. Data by PE - PP9	Active Proposal Histogram - PB4	Proposal by User - Selected Criteria - PA9'	Proposal Information Report - PE8	Proposal With Int'l Implication - PC1	Special Program Data Fields - PA1
Institution Code	29													■										29			■		■			
Institution Name and Data	30	■	■	■	■	■	■	■	■	■	■		■		■	■	■	■			■	■		30		■				■		
Object Class Code	31	■	■	■	■	■	■			■	■			■	■		■	■			■			31	■	■				■		
Obligations	32																							32	■							
Operating Plan Code	33																							33								
Organization Code	34		■	■		■	■	■	■	■	■			■	■		■	■			■			34	■	■		■	■	■	■	
Other Financial Systems Data	35																							35		■						
PI/PD Data	36		■	■	■	■	■	■	■	■	■			■	■	■	■	■			■	■		36		■	■		■	■		
Program Element Code	37	■	■	■		■	■			■	■			■	■		■	■			■			37	■	■			■	■		
Program Name/Reference Code	38															■			■	■				38								
Proposal Amount	39		■	■	■				■		■		■	■	■		■	■	■	■	■	■		39		■			■	■		
Proposal/Award Number	40		■	■	■	■	■	■	■	■	■			■	■	■	■	■				■		40	■	■	■		■		■	
Proposals Age in Months	41														■								■	41				■				
Proposal Actions/Pending	42														■								■	42								

Senator Garn—Continued

CROSS REFERENCE MATRIX OF RESOURCES AND DATA TYPES

	PROPOSAL INFORMATION (BATCH)	Proposals/Awards by Principal Field of Science	Cumulative Actions by State/Cong. Dist.	Cumulative All Actions (POA)	Cumulative All Actions (POS)	Cumulative All Awards (POA)	Cumul List Awards State/Cong Dist	Cumul. List. Awards Int'l Impl.	Daily List of Proposals Received	Daily List of Proposals Recommended	Detailed List. Actions 9-12 / over 12 mos.	Fiscal Year Grants & Contracts (TARA)	Props. Rcvd/Actions Taken by State/Inst.	PAIS Verification of All Actions	Pending Props. by Org. (9-12 / over 12 mos.)	Proposal Evaluation Form	Workload Stat. Rept. - Fiscal Year Awards only	Workload Stat. Rept. - FY Props Actions	Props. Rcvd/ Actions (NSB Stats) Summary	Props. Rcvd/ Actions (NSB Statistics)	Recom'd. Props - Funds Reserved by Org.	Report of Award Actions (NSB Rept.)	Summary of Actions (Monthly & Cumulative)
Proposals Received/Reserved	43																						■
Other Proposal Data	44	■	■	■	■	■	■	■	■	■					■	■					■	■	
Proposal Statistics	45												■						■	■			
Recommend Data	46									■			■	■									
Registry Number	47																						
Requested Duration	48								■														
Reviewer Data	49																						
Special Data Fields	50																						
Split Data	51																■	■					
State Abbreviation	52																					■	
Sub-Appropriation	53																						
Summary Awards Data	54											■											
Total Program Activity	55																	■		■	■		■
Type of Request/Award Code	56										■			■			■	■					

	PROPOSAL INFORMATION (ON-LINE)	Financial Split Record Display - PS2	Proposal & Application Info. Sys. - PU3	Recomm., Resvtion, Awd. Data by PE - PP9	Active Proposal Histogram - PB4	Proposal by User - Selected Criteria - PA9	Proposal Information Report - PE8	Proposal With Int'l Implication - PC1	Special Program Data Fields - PA1
Proposals Received/Reserved	43								
Other Proposal Data	44		■				■		
Proposal Statistics	45								
Recommend Data	46	■	■	■			■		
Registry Number	47	■							■
Requested Duration	48		■			■	■		
Reviewer Data	49								
Special Data Fields	50								■
Split Data	51	■	■						
State Abbreviation	52	■							
Sub-Appropriation	53								
Summary Awards Data	54								
Total Program Activity	55								
Type of Request/Award Code	56		■	■		■	■		

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CROSS REFERENCE MATRIX OF
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	PROPOSAL INFORMATION (OFFICE -BATCH)	Props by Org/Disp/Date Rcvd - PR1	Props by Org/Disp/Program Element - PR2	Proposals by Organization/Disposition - PR3	Props by Org/Disp/Disp Date - PR4	Props by Institution/Organization - PR5	Props by Organization/Institution - PR6	Props by Organization/Object Class - PR7	Summary Report of Disposition (Org/PE) - PS1	Sum'y of Awd Types (Org/Obj) Class - PS2	Sum'y of Success Pcts (Org/Awd Type/Obj Cl)-PS	Chart of Props for Data Elem (Org/Disp) - OT2	Obligations & Future FY Commts by Org - OT3	PROPOSAL INFORMATION (OFFICE - ON-LINE)	Single Proposal Info Available On-Line - ON1	PI/PD INFORMATION (BATCH)	PI/PD History of Past Proposals	PI/PD INFORMATION (ON-LINE)	PI/PD History Report & Name Search - IB4	REVIEWER/PANELIST INFORMATION (ON-LINE)	Reviewer Attributes Assignments - RS1	Reviewer Attribute Search - RS2	Reviewer/Panelist Name Search - RS7	REVIEWER/PANELIST INFO (OFFICE - BATCH)	Reviewer by Organization - OT4
Action Date	1													1		1		1		1				1	
Actions Statistics	2													2		2		2		2				2	
Amendment Data	3												■	3	■	3	■	3	■	3				3	
Amt Prop'd-Declines/Withdrwls	4										■			4		4		4		4				4	
Appropriation	5													5		5		5		5				5	
Available Balance	6													6		6		6		6				6	
Award Amount	7	■	■	■	■	■	■	■			■		■	7	■	7		7		7				7	
Award Date	8													8		8		8		8				8	
Award Duration	9													9	■	9	■	9		9				9	
Award Number	10												■	10	■	10		10	■	10				10	
Award Data - Other	11	■	■	■	■	■	■	■					■	11	■	11		11		11				11	
Budget Data	12													12		12		12		12				12	
Category of Request/Award	13											■		13	■	13		13		13				13	
CO-PI Name	14													14		14		14		14				14	

Senator Garn—Continued

CROSS REFERENCE MATRIX OF RESOURCES AND DATA TYPES

	Commitment Data	Congressional District	Continuing Grant-Year & Amount	Country Data	Date Proposal Received	Date Reviewer Last Changes/Used	Directorate Name	Disposition Data	Fle of Application/Sci Cd (FOA/FOS)	Fiscal Year Data	Foreign Country Name	Future Commitment Amount/Year	Grantee or Contractor Name	Institution Address
PROPOSAL INFORMATION (OFFICE -BATCH)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Props by Org/Disp/Date Rcvd - PR1					■			■						
Props by Org/Disp/Program Element - PR2					■			■						
Proposals by Organization/Disposition - PR3					■			■						
Props by Org/Disp/Disp Date - PR4					■			■						
Props by Institution/Organization - PR5					■			■						
Props by Organization/Institution - PR6					■			■						
Props by Organization/Object Class - PR7					■			■						
Summary Report of Disposition (Org/PE) - PS1								■						
Sum'y of Awd Types (Org/Obj Class - PS2								■						
Sum'y of Success Pcts (Org/Awd Type/Obj Cl)-PS														
Chart of Props for Data Elem (Org/Disp) - OT2					■			■	■					
Obligations & Future FY Commts by Org - OT3														
PROPOSAL INFORMATION (OFFICE - ON-LINE)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Single Proposal Info Available On-Line - ON1					■			■	■			■		■
PI/PD INFORMATION (BATCH)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
PI/PD History of Past Proposals									■					
PI/PD INFORMATION (ON-LINE)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
PI/PD History Report & Name Search - IB4					■				■					
REVIEWER/PANELIST INFORMATION (ON-LINE)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Reviewer Attributes Assignments - RS1						■								
Reviewer Attribute Search - RS2						■								
Reviewer/Panelist Name Search - RS7														
REVIEWER/PANELIST INFO (OFFICE - BATCH)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Reviewer by Organization - OT4														

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CROSS REFERENCE MATRIX OF
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	PROPOSAL INFORMATION (OFFICE -BATCH)	Props by Org/Disp/Date Rcvd - PR1	Props by Org/Disp/Program Element - PR2	Proposals by Organization/Disposition - PR3	Props by Org/Disp/Disp Date - PR4	Props by Institution/Organization - PR5	Props by Organization/Institution - PR6	Props by Organization/Object Class - PR7	Summary Report of Disposition (Org/PE) - PS1	Sum'y of Awd Types (Org/Ob) Class - PS2	Sum'y of Success Pcts (Org/Awd Type/Obj Cl)-PS	Chart of Props for Data Elem (Org/Disp) - OT2	Obligations & Future FY Commts by Org - OT3	PROPOSAL INFORMATION (OFFICE - ON-LINE)	Single Proposal Info Available On-Line - ON1	PI/PD INFORMATION (BATCH)	PI/PD History of Past Proposals	PI/PD INFORMATION (ON-LINE)	PI/PD History Report & Name Search - IB4	REVIEWER/PANELIST INFORMATION (ON-LINE)	Reviewer Attributes Assignments - RS1	Reviewer Attribute Search - RS2	Reviewer/Panelist Name Search - RS7	REVIEWER/PANELIST INFO (OFFICE - BATCH)	Reviewer by Organization - OT4
Institution Code	29											■		29	■	29		29		29				29	
Institution Name and Data	30	■	■	■	■	■	■	■				■	■	30	■	30	■	30		30	■	■	■	30	■
Object Class Code	31	■	■	■	■	■	■	■	■	■		■		31	■	31		31		31				31	
Obligations	32													32		32		32		32				32	
Operating Plan Code	33													33		33		33		33				33	
Organization Code	34	■	■	■	■	■	■	■	■	■		■	■	34	■	34	■	34	■	34				34	■
Other Financial Systems Data	35													35		35		35		35				35	
PI/PD Data	36	■	■	■	■	■	■	■					■	36	■	36	■	36	■	36				36	
Program Element Code	37	■	■	■	■	■	■	■	■	■		■		37	■	37		37		37				37	
Program Name/Reference Code	38											■		38		38		38		38				38	
Proposal Amount	39	■	■	■	■	■	■	■	■	■	■			39	■	39	■	39	■	39				39	
Proposal/Award Number	40	■	■	■	■	■	■	■					■	40	■	40	■	40		40				40	
Proposals Age in Months	41													41		41		41		41				41	
Proposal Actions/Pending	42													42		42		42		42				42	

Senator Garn—Continued

CROSS REFERENCE MATRIX OF
RESOURCES AND DATA TYPES

	PROPOSAL INFORMATION (OFFICE -BATCH)	Props by Org/Disp/Date Rcvd - PR1	Props by Org/Disp/Program Element - PR2	Proposals by Organization/Disposition - PR3	Props by Org/Disp/Disp Date - PR4	Props by Institution/Organization - PR5	Props by Organization/Institution - PR6	Props by Organization/Object Class - PR7	Summary Report of Disposition (Org/PE) - PS1	Sum'y of Awd Types (Org/Obj) Class - PS2	Sum'y of Success Pcts (Org/Awd Type/Obj Cl)-PS	Chart of Props for Data Elem (Org/Disp) - OT2	Obligations & Future FY Comtmts by Org - OT3	PROPOSAL INFORMATION (OFFICE - ON-LINE)	Single Proposal Info Available On-Line - ON1	PI/PD INFORMATION (BATCH)	PI/PD History of Past Proposals	PI/PD INFORMATION (ON-LINE)	PI/PD History Report & Name Search - ID4	REVIEWER/PANELIST INFORMATION (ON-LINE)	Reviewer Attributes Assignments - RS1	Reviewer Attribute Search - RS2	Reviewer/Panelist Name Search - RS7	REVIEWER/PANELIST INFO (OFFICE - BATCH)	Reviewer by Organization - OT4
Proposals Received/Reserved	43													43		43		43		43				43	
Other Proposal Data	44	■	■	■	■	■	■	■	■	■	■	■		44	■	44	■	44		44				44	
Proposal Statistics	45													45		45		45		45				45	
Recommend Data	46											■		46	■	46		46		46				46	
Registry Number	47													47		47		47	■	47				47	
Requested Duration	48	■	■	■	■	■	■	■				■		48	■	48		48	■	48				48	
Reviewer Data	49													49		49		49		49	■	■	■	49	■
Special Data Fields	50											■		50	■	50		50		50				50	
Split Data	51	■	■	■	■	■	■	■						51		51		51		51				51	
State Abbreviation	52											■		52		52		52		52				52	
Sub-Appropriation	53													53		53		53		53				53	
Summary Awards Data	54										■			54		54		54		54				54	
Total Program Activity	55													55		55		55		55				55	
Type of Request/Award Code	56											■		56	■	56		56		56				56	

Senator Garn—Continued

CROSS-DISCIPLINARY RESEARCH CENTERS IN ENGINEERING

Question: Could you please describe the current problems that you see in engineering research and teaching that this new initiative will address?

Answer: Except in certain cases, cross-disciplinary research efforts in engineering are currently inadequate. Yet rapid advances in technology are driving engineering toward cross-disciplinary interactions. These technological advances are also leading toward integration among design, engineering, manufacturing, and marketing. There is a need for engineers with a broad understanding of the overall manufacturing system and of the interrelations among its components.

Simultaneously, advances in design and manufacturing technology are creating a growing gap between industrial technology and university facilities and capabilities. Engineering education must provide at least a working understanding of computer-aided design, manufacturing automation and control, and communication technologies. It must also provide an understanding of new materials and materials processing technologies.

A closely related issue is the need for more exposure of engineering students to engineering practice. Engineering education must provide opportunities for "hands-on" experience with real (although often scaled down) design and manufacturing problems. It must also provide exposure to industrial environments. The need here is for working interactions with industry engineers and problems, not just increased industry funding.

Finally, engineering education must reflect the team nature of engineering as well as prepare young engineers for the problems of developing and managing a productive work force.

Question: Could you please describe the specific type of cross-disciplinary research in engineering that you would expect to be supporting at these centers?

Answer: There are many examples of cross-disciplinary activities in engineering that represent major areas of concern and that could be supported at these centers. Among these are computer integrated manufacturing systems, bioengineering processing systems, lightwave technology, construction engineering, and robotics, among others.

Question: Your budget justification indicates that the $10 million requested is for the first year of this activitiy. How much do you expect would be required in subsequent years?

Answer: No definitive out-year estimates have been determined. However, if substantial progress is evident, total support for the Engineering Centers could reach $100 million by FY 1990.

Question: How many Centers do you have in mind during FY 1985 and how many would eventually be included in this initiative?

Answer: In FY 1985 we are planning for approximately 5 centers. If substantial progress is made, upwards of 25 centers are planned by FY 1990.

Question: What type of contractual relationship would you expect to establish with these centers -- in terms of multiyear Federal funding commitments, industry matching funds, and measures of research and teaching productivity?

Answer: Each center is to be funded for a minimum of 5 years. The centers are expected to seek industry participation, in the form of either matching funds, or in-kind contributions such as facilities, non-proprietary systems, personnel, etc.

Funding of the centers will be planned so as to affect directly at least 10 percent of all the graduate engineering students in the center's home institution. The centers also allow for significant undergraduate participation.

Question: What plans have you developed to evaluate the effectiveness of this approach in increasing the supply and quality of research oriented engineers?

Answer: While each center can count on five-year initial commitment, a detailed site review will be conducted after the third year in order to determine whether further funding is warranted. Following a favorable review, a three-year extension on the initial five-year commitment would be awarded with a recurring cycle thereafter of three years. The effectiveness of the center approach will be evaluated based on the impact that the centers have on the quality of engineering research and education. Two types of impacts can be identified, broad impacts and specific impacts.

The following broad impacts are expected of each center:

- enhanced institutional innovation and creativity--between university and industry, as well as between educational institutions and non-profit organizations, governmental entities and professional societies;
- an environment that fosters the development of new cross-disciplinary research initiatives;
- experience in the synthesis of knowledge to augment the classroom teaching of analysis and design; and
- central experimental facilities, developed, operated, and maintained to facilitate ERC research proejcts, but also available to other researchers on the campus.

In addition, the following specific impacts are expected.:

- demonstrable results of joint university-industry research programs;
- new educational materials resulting from the codification of new knowledge generated by the research programs;
- a regional impact on engineering education; and
- identifiable efforts to promote the transfer of knowledge to engineering practitioners.

SEMINARS IN INNOVATION PRODUCTIVITY

Last year I asked you to describe the major conclusions and findings of a study which was designed to identify innovation strategies that proved successful in 110 U.S. factories throughout the past decade.

At that time you stated that the research project was still in progress and that consequently the findings were preliminary.

Question: What are the major findings to date?

Answer: In general the findings tend to confirm to what has become conventional wisdom in the organization behavior literature, namely:

- small high technology firms do tend to be more innovative than larger firms for products which are rather complex and require few repetitive tasks to produce them. These firms are also less hierarchical, employ relatively more specialists, and tend to control by feedback rather than by plans.
- larger firms are more productive than smaller firms for producing relatively simple products which require many repetitive tasks. Larger firms are also more hierarchical, employ fewer specialists and control by plan.

The most interesting finding is that there is a small but growing middle range of firms that are both innovative and productive for a variety of technologies and markets.

- their organizational designs tend to be relatively hierarchical, but employ relatively many specialists and control both by feedback and plan.
- a critical factor in achieving both innovation and productivity seems to be the location of the R&D function on site.
- these firms tend to be in "process" industries (i.e. chemicals), but there are a number of non-process types among the sample.

VENTURE CAPITAL STUDY

In describing some of the projects that have been funded through the Foundation's Industrial Science and Technology Innovation program you note a particular study on venture capital. The study concluded that the availability of investment opportunities was more of a constraint than the availabililty of capital. Thus policies which stimulate new technological breakthroughs may be more appropriate than policies which stimulate the availability or flow of venture capital.

Question: Could you please comment on the implications of this finding for NSF's activities -- in particular your Small Business Innovation Research program?

Answer:

- The conclusion cited does not distinguish between "high technology" investments and other investments. The needs of each type of investment are different. SBIR aims at high technology, high risk advanced research.
- High technology investments require significant amounts of non-monetary, "value added" assistance. This type of assistance includes contacts with suppliers and output markets as well as organizational expertise. This finding is supported by preliminary results of another venture capital study (by Venture Economics), where founders of highly innovative technological ventures reported that "it is more important who they obtain funding from, than how much and at what price."
- NSF can play a significant role in providing such "value added" assistance. It can serve as a broker between innovative research opportunities and those seeking to invest in such opportunities.
- SBIR funding often serves as pre-venture capital funding, particularly to very small firms. Venture capitalists are increasingly interested in high technology firms. However, for the most part they are not interested in research at the idea or concept stage, except in a few "hot" areas. Venture capitalists want firms with proven working prototypes or existing innovative products. SBIR funds advanced research in NSF program areas at the idea or concept stage. More than 40 percent of SBIR awards have gone to firms with 10 or fewer employees.
- The SBIR Program is a key vehicle for finding such basic research opportunities among small firms. SBIR funds do not provide the majority of a small firm's capital needs. However, SBIR does offer small firms a "carrot" that induces them to come forward with promising research ideas.

AID FOR THE U.S. MACHINE TOOL INDUSTRY

Last year we discussed a National Academy of Engineering Report on the U.S. Machine Tool Industry. The report concludes that the U.S. Machine Tool Industry, a vital cog in this country's industry and national security, is facing a bleak future because of its sharply declining share of international and domestic markets.

I asked you if the Foundation agreed with the panel's findings that the machine tool industry is a "crucial element" in increasing industrial productivity?

You stated "It cannot be emphasized too strongly that the industry is an essential foundation stone for the Nation's productivity as well as for its defense."

Question: Given this assessment, what role have you identified for NSF since our last hearing? And what resources do you expect to devote to this issue during FY 85?

Answer: The National Science Foundation's Production Research Program has a specific goal to establish and support a group of projects for research on machining and machine tools. That goal has been reached in FY 84, the Program having eleven active projects with two more grants about to be made. The goal will still be in effect in FY 85, when it is expected that about one and one-half million dollars of research will be in progress. Further efforts are also being made to find out, directly from executives in the industry, what the research priorities are.

An executive from the industry serves on the Program's Advisory Panel.

NEW GRADUATE FELLOWSHIPS

Question: Why do you consider it important again, this year, to have a further increase in the yearly stipends?

Answer: The Foundation attaches a high priority to maintaining the momentum initiated last year of stipend increases for NSF Graduate Fellows. Since this is the only program in which the Federal government seeks to attract the Nation's most talented students in all fields of science and engineering to graduate study, it is essential that these students be provided with a stipend that both is and is perceived to be at a sufficient level to sustain independent full-time graduate study.

Question: Do you consider this increase in stipends more important than restoring the 50 fellowships added by the Congress last year?

Answer: The Foundation feels that a decrease of 50 new awards is fully justified in light of necessity to eventually reach a more realistic stipend level.

Question: How do these new proposed stipends and the cost-of-education allowances compare to other fellowship programs such as DOD and ONR?

Answer: The lowest current stipend in the graduate fellowship programs sponsored by the various branches of the Department of Defense is $12,000 per year, and the cost-of-education allowances cover full tuition and fees. NSF's yearly stpiend is $8,100 in FY 1984 and $9,000 in FY 1985. The annual cost of education allowance is $4,900 for both FY 1984 and FY 1985.

Question: How many individuals will apply for NSF fellowships during FY 1985?

Answer: We anticipate 4,500 applications for NSF Graduate Research Fellowships in FY 1985.

AVAILABILITY OF FUNDS FOR SCIENCE AND ENGINEERING EDUCATION ACTIVITIES

Question: Your appropriations language for Science and Engineering Education for FY 85 requests that the appropriated funds be made available for two fiscal years -- FY 85 through FY 86.

Question: Why do you feel that it is necessary to have two year money for this activity?

Answer: The availability of funds over a two-year period will provide maximum flexibility in managing the science education program to allow enough time for the review of proposals and staff decisions to assure that the highest quality ideas are supported. Furthermore, two-year appropriations put science education on the same basis as the research and related activities.

Question: What would be the effect of making the FY '85 appropriated funds available only through the end of that fiscal year?

Answer: Due to the complexity of the program, the time requirements for proposals development, review and decision-making, and possible staff limitations, there is the possibility that not all the funds could be obligated.

SCIENCE AND ENGINEERING EDUCATION (SEE)

During FY 84 the average amount requested in a proposal in your Science and Engineering Education Activities program was approximately $90,000. During 84 you expect to fund proposals with an average cost of around $48,000 or approximately 54% of the amount requested. During FY 85 you estimate that the average amount requested for proposal will be $116,00 and you expect to fund proposals with an average cost of $41,000. This represents a funding of 36% of the average amount requested.

Question: Why is there such a discrepancy in the average size of the requests in this area and the average size of the award and why does this discrepancy seem to be growing?

Answer: In computing the average award in precollege science and mathematics education (QDT-51 of the FY 1985 NSF Budget Request), each Presidential Award is counted as one award. That means a total of 104 awards at $5,000 each were added into the amount of the average for all precollge awards. The effect was to pull down the amount of the average award. Below is a table which shows an increase of about 5% in the average award amount from FY 84 to FY 85 if the Presidential Awards are not included in the computation.

(Dollars in Thousands)

	FY 1984	FY 1985
Presidential Awards		
Number of Awards	104	104
Total Amount Awarded	$ 520,000	$ 520,000
Average Amount Per Award	5,000	5,000
All Other Precollege Awards		
Number of Awards	229	174
Total Amount Awarded	$68,071,597	$54,180,000
Average Amount Per Award	279,255	311,379

Furthermore, in computing the overall average award for the Directorate for SEE (QDT-49 of the FY 1985 NSF Budget Request), the awards for Graduate Fellowships are included in the total. While most awards in the Graduate Fellowship program are similar in average amount (i.e., $13,500), they are significantly smaller than the average non-Presidential precollege award. The combined effect of factoring the Graduate Fellowships and the Presidential Awards into the SEE total average results in pulling down the average award size.

There is a single award to the National Academy of Sciences in the amount of $800,000 for support services on the Graduate Fellowship program.

INDUSTRIAL SCIENCE AND TECHNOLOGY INNOVATION

In FY 85 you are requesting an increase of $5.8 million in your Industrial Science and Technology Innovation program in order to comply with the percentages required under the Small Business Innovation Development Act of 1982.

Question: As a result of that increase how many Phase I and Phase II awards will be made during FY 85 and how does this compare to the FY 83 and FY 84 levels?

Answer:

Number of Awards and Average Award Amount

	FY 1983		Est. FY 1984		Est. FY 1985	
Phase I (six months)	(4)	30K	(100)	35K	(110)	40K
Phase II (two years)	(33)	200K	(35)	200K	(40)	200K

The SBIR policy directives from SBA and the legislative history allow Phase I awards to average up to $50K and Phase II awards up to $500K.

NSF Phase I awards started at $25K in 1977. Phase II awards have remained at $200K since the beginning of the program in 1977 due to funding limitations. We expect them to increase to $250K in FY 1986.

SCIENCE AND ENGINEERING EDUCATION STAFFING

During FY 84 you expect your science and engineering education directorate to have a full-time employment level of 45. In FY 85 you are asking for 55 FTE.

Question: Could you please explain why these additional 10 FTE will be required in FY 85?

Answer: The Foundation has reestablished a Directorate for Science and Engineering Education in response to an increased emphasis on science education and to administer new functions and responsibilities. After careful consideration and consultation with the National Science Board and others, an internal organization structure has been established to manage the activities of the Directorate.

During the start-up phase for this new Directorate in FY '84, considering the time needed to develop an internal organization and to recruit and bring on board staff of the highest quality possible, 45 FTE (51 positions) was considered to be a reasonable level. Recruitment for these staff is now underway.

However, our best estimate is that a staff of approximately 55 FTE (61 positions) will be required to handle the workload in FY '85 in further developing and managing a science education program responsible to the Congress, the National Science Board, the NSB Commission and others.

Question: Could you please provide for the record a description of the organizational structure for this Directorate and the number of FTE associated with each function in FY 84 and FY 85?

Senator Garn—Continued

Answer: The organizational structure for the Science and Engineering Education Directorate consists of the following:

	FTE FY 84	FTE FY 85
Office of the Assistant Director For SEE		
Provides overall management planning and policy guidance, coordination and oversight of the Directorate activities.	7	7
Office of Research Career Development		
Administers grant and post-doctoral programs and coordinates the Presidential Young Investigator Awards.	8	9
Office of Special Activities		
Responsible for informal science education, information in science and mathematics education and studies and analyses of precollege science education.	8	9
Division of Precollege Education in Science and Mathematics		
Responsible for initiation and support of precollege materials development and research and teacher development and incentives awards.	22	30
TOTAL	45	55

USE OF COMPUTERS IN SCIENCE EDUCATION

Last year we discussed a pioneer program involving the donation of equipment by private industry aimed at improving science and engineering education in public schools and at the early college levels through the use of computers and other information handling equipment. A number of companies committed to provide computers and related hardware, technical information about the equipment and expert assistance so that the computers could be used to the best advantage.

At that time I asked what specific evaluation NSF intended to undertake in order to determine the effectiveness of the various projects in improving the knowledge of science and engineering students. You stated you would be exploring various plans for a third party evaluation of this program.

Question: What is the current status of this evaluation?

Answer: We have developed a plan for an independent third-party evaluation of this program and have received comments from the NSF staff for improving this plan.

The next step is to send the plan to the cooperating companies that made the computer donations for their comment. We expect to do this within the next month.

The projects in this program do not expire for another two years. One-third expire in March 1986 and two-thirds in June 1986. We will have to wait until then to get initial results. This will focus on the quality and utility of the products and results produced. The evaluation will address such questions as the value and utility of the outcomes of the individual projects and the program as a whole, taking special account of the unusual feature, namely, the donations. The evaluations will have three phases:

- Phase I. This phase is to produce a detailed compilation and description of the objectives and anticipated results set forth in the 57 proposals. This is done by analysis of the proposals and telephone and letter communication with the 57 project directors.
- Phase 2. This phase is to produce a detailed compilation and description of the actual outcomes, products, and results of the projects, following their completion. This will include the building of a collection of reports, computer programs, discs, etc. that comprise these outcomes, products, and results. Also, included is a report on the status and availability of the a varous items in this collection.
- Phase 3. Using the collection assembled in Phase 2 above, this phase is to address the judgmental value, utility and cost-effectiveness issues. An effort will be made to make comparisons with suitable commercial or other products produced by individuals and organizations without external support.

Effects on student learning are beyond the scope of the evaluation we plan. This would be very expensive to do and the expected results would not justify the cost. Moreover, the program is aimed at development of prototypes of computer-based instructional materials or model programs, and not directly on student learning as such. Accordingly, the evaluation will address the program's primary goals.

PRIVATE SECTOR SUPPORT OF ACADEMIC COMPUTER RESEARCH

In describing the Foundation's activities in the computer research area you note that computer vendors and other companies in the information processing industry are supporting academic computer research to a greater and greater extent. In fact you state that the "total investment by industry has been increasing in response to the critical situtation in academic computer research and is now comparable to the total NSF support in this area."

Senator Garn—Continued

Question: What if anything is the Foundation doing to encourage such support by the private sector?

Answer: The Foundation is encouraging support by the private sector in many ways.

1) In some programs, e.g. the Computer Research Equipment program, the Foundation requires substantial cost sharing by the submitting institution. Many institutions obtain part of their share from private sources.

2) In the Coordinated Experimental Research program, the Foundation helps provide equipment, maintenance and technical assistants to conduct experimental research but requires the institution to share in the cost and to seek support for the conduct of the research through other proposals. Many institutions meet part of their cost-sharing requirement from private sources. Also, the experimental research which these awards make possible is often of interest to industry which results in private participation in the support of the research.

3) NSF has been taking the lead in creating public discussion of faculty and graduate student shortages in computer research. This has helped alert industry to the need for private support of the universities in order to strengthen the Nation's posture in computer technology.

Question: What implications does such private sector investment have in terms of the Foundation's activities -- that is, have you identified specific areas where the Foundation should target its resources to cover those areas that are not being funded by industry?

Answer: NSF plays a balancing role, not only with respect to private sector support of research but also with respect to the support provided by other agencies.

During the last few years, private research activity and private support for academic research have increased markedly. Some of the most notable activities are:

1. The MCC is a consortium of companies in the computer industry which was formed to pool some of their R&D resources. MCC will perform longer term industrial R&D in selected areas. IMB is not a participant. Although MCC will be a research performer, it depends upon the people and ideas resulting from academic research. Its existence increases the need for NSF programs.

2. The Semi-conductor Research Consortium (SRC) is channeling private support into academic research in electronic materials and VLSI technology. Its current budget is less than $15M but expected to grow. The effect of SRC support is to increase the emphasis of academic research on areas of concern to the semiconductor industry. Its relation to NSF research may be gauged by comparing the magnitude of its support to the $25M provided by NSF's programs in Materials Research and Electrical, Computer and Systems Engineering in similar areas. It is a major influence but does not replace NSF. On the contrary, it highlights the national need for more emphasis on materials

research and engineering, both to improve the infrastructure of science which supports the SRC projects and to strengthen the broad base of knowledge which contributes in unpredictable ways to the areas of specific interest to SRC.

3. Large corporate members of the computer industry have been increasing their support of academic research during the last few years. It is difficult to track that activity since we have no systematic reporting mechanisms, but inquiries to major participants show that the total, exclusive of educational discounts on equipment purchases, may be on the order of $55 million per year. This exceeds NSF support in related areas. Much of the corporate support is for equipment, approximately. $29 million, which leaves a balance of $26 million for fellowships, research projects, and other activities. In Computer Research, much of the research project support requires specific deliverables in the form of software packages or reports. This appears to depend upon, rather than replace, NSF support for undirected research and infrastructure. As a result, the effect of this private support also is to highlight the national need for NSF programs.

SUPPORT FOR SUPERCOMPUTER RESEARCH

During FY 84 the Foundation expects to provide approximately $8 million in support of architecture design and software applications specifically related to supercomputers. I understand that in FY 85 you expect this support to increase to approximately $10 million.

Question: What relationship will this research support through your Division of Computer Research, bear to your initiative in establishing supercomputing centers?

Answer: There is a distinction between the immediate need for access to supercomputers by researchers in many disciplines and research on future architecture and software applications. However, these two activities will draw together in future as researchers gain experience with supercomputers and begin to tackle new classes of problems. New, more efficient programs, and eventually new architectures will be needed.

Present and future Division of Computer Research (DCR) support is aimed at the understanding of the entire computer environment, part of which pertains to supercomputers.

DCR research support will contribute to future architectural design and design of software systems to enhance the performance of future computers and future supercomputers.

Question: In particular, how will the development of supercomputer software thrugh the Computer Division's research program be related to user needs that are identified in the Supercomputer Center Program?

Answer: DCR research is not related specifically to satisfying current user needs in supercomputer centers, and most of the software needed for use by researchers in specific disciplines is developed by those disciplines. However, research supported in the past by DCR should facilitate conversion now of programs to use supercomputers.

CONSOLIDATED LIST OF COMPUTER RELATED COSTS

Question: Please prepare for the record an estimate of the amount of funds within the Research and Related Activities Account devoted to the purchase, use and support of computers or computer facilities during FY 83, FY 84 and FY 85.

Computer-Related Support
(In Millions of Dollars)

FY 1983	FY 1984	FY 1985
$33.5	$ 54.4	$ 79.2

PHYSICS AND SUPERCOMPUTERS

In describing your gravitational physics program for FY 85 you indicate that increased support in this area will permit new types of theoretical calculations using supercomputers.

Question: Do you have in mind the use of the NSF established supercomputer centers or the use of supercomputers at other Federal and foreign facilities?

Answer: University scientists in the Gravitational Physics Program have been investigating problems such as accretion onto black holes, stellar collapse, supersonic radio jets, and cosmology using available supercomputers. In the past, this has required them to travel to fully configured systems at National Laboratories (Livermore, Los Alamos), industry (Digital Productions, Cray Research), and foreign centers (Max Planck Institute, Garching, West Germany). These will continue to be used in FY 1985, as will any new supercomputer centers from which NSF establishes or purchases blocks of time.

COMPUTER RESEARCH PROGRAM

For the record could you please describe the importance of each of the following programs, the amount of NSF support associated with each of these programs in FY 83, FY 84 and FY 85 and the percent of total federal support for each of these areas that is derived from NSF funding.

Senator Garn—Continued

Question: Could you please, also describe some of the major accomplishments in each of these fields over the last several years.

- Software Systems Science
- Intelligent Systems
- Coordinated Experimental Research

Answer:

Software Systems Science

Investigates the basis for programming languages, operating systems, database management systems, etc. that may be needed ten years or more in the future.

	FY 1983	FY 1984	FY 1985
NSF support	$3,150,586	$3,700,000	$4,200,000
Est. % of Fed. Supp.	50%	50%	50%

Accomplishments

Rapid prototyping of complex systems is facilitated by advanced languages. The first Ada compiler to be certified was produced via the SEIL language, support for which began in 1971 from this program.

Intelligent Systems

Supports the study of systems to provide high level (quasi-intelligent) support in decision making. Some such systems might eventually be autonomous.

	FY 1983	FY 1984	FY 1985
NSF support	$3,016,965	$3,400,000	$3,700,000
Est. % of Fed. supp.	20%	20%	15%

Accomplishments

A system (MOLGEN) under development at Stanford University provides intelligent assistance to the design of laboratory experiments in molecular biology. It is one of several systems to demonstrate, in recent years, the potential of knowledge-based systems.

Coordinated Experimental Research

The Coordinated Experimental Research Program was begun in 1980; has been highest priority program in DCR; goals; to attract faculty and graduate students into experimental computer research; to help to build the necessary infrastructure for experimental computer research.

Early indications from current CER grantees, the CER Program oversight committee and others in the community show positive trends in graduate enrollment and faculty hiring; substantial increases in research activity at the FY 81 and FY 82 CER sites as measured by annual grant and contract support.

FY 1983	FY 1984	FY 1985
$ 11.2M	$ 13.7M	$ 16.7M

Accomplishments

CER accomplishments include the computer science research network, CENET and 14 substantial five-year grants for equipment, support staff and services.

Your budget justification indicates that in FY 85 you expect to fund approximately 53% of the proposals submitted in your computer research program. However, you estimate that, only 21% of the dollars requested would be funded.

Question: It would appear that the Foundation is selecting smaller grants for funding -- is this true and why?

Answer: The Foundation does not preferentially select smaller grants for funding. There are two principal causes of the large discrepancy between funds requested and awards made.

1) Approximately one-half of the total requests are from Coordinated Experimental Research proposals. This program has a success ratio of only 20-25%. Also, requests in this program always show the total for five years but awards are made through 5-year continuing grants which show only one year funding at a time. Finally, in this program, evaluation of the proposals commonly dictates negotiation of reduced budgets on those proposals which are selected for support.

2) In the regular science research project proposals, many proposals request multiple year support but awards are often made through continuing grants. As a result, requests show the total for the duration of the project but the awards show only the funding for one year.

EARTHQUAKE RESEARCH

During FY 84 you requested $19 million for your Earthquake Hazard Mitigation program. Your FY 84 operating plan allocated $17.6 million to that program. Your budget justification indicates that this reduction was the result of "congressional direction".

Question: Could you please indicate the Congressional Committee that directed this reduction in your Earthquake Program?

Answer: The Congressional Committee that directed the reduction in the Earthquake Hazard Mitigation Program was the House Appropriations Subcommitee on HUD-Independent Agencies

The House Subcommittee recommended a cut of $1,500,000 from the requested FY 1984 amount of $2,300,000 for Societal Response Earthquake Research. This recommendation was accepted by the full House Appropriations Committee as indicated in its report on the FY 1984 appropriations bill. This reduced budget became part of the final NSF FY 1984 appropriation.

EARTH SCIENCES PROGRAM SUBACTIVITY

Your FY 84 budget contained a request for $3.7 million for research on the continental lithosphere. In FY 85 you are requesting $7.7 million for this research. This represents an increase of $4 million, essentially doubling the programs level of effort.

Question: Why has the Foundation chosen to increase this program at such a fast rate during FY 85?

Answer: The earth sciences are developing rapidly, lithospheric research in particular. This is reflected in a recently completed study of research needs and priorities in the earth sciences by the National Academy of Sciences: Opportunities for Research in the Geological Sciences (NAS/NRC September 1983). The number one research priority identified in this report is "a more detailed and accurate definition of the structure and composition of the continental lithosphere, including the continental margins." This priority item was confirmed and amplified in a special briefing for Dr. Keyworth and me by the Committee on Science, Engineering, and Public Policy (COSEPUP) Research Briefings 1983, NAS/NRC, November 1983).

Question: Do you expect that these additional funds will be used to support a large number of small grants or does the Foundation expect to fund several large proposals that would use most of these funds?

Answer: These funds will be used to support a few relatively large multi-institutional projects of broad interest to the earth sciences. Increases in other earth science programs are expected to result in an overall increase in the number of individual earth science grants.

ANTARCTIC R&D

How much of the Antarctic R&D is targeted for the suport of continuing data collection efforts and how much for non-recurring R&D? Please provide this data for FY 83, FY 84 and FY 85.

Answer: The breakout within the U.S. Antarctic Research Program subactivity is as follows:

Senator Garn—Continued

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Estimate
Automatic Weather Station	$ 246,578	$ 180,000	$ 189,000
Bartol Research Foundation, Cosmic Ray Monitoring at McMurdo and South Pole	225,971	226,000	237,300
UCLA Earth Gravity Tides at South Pole	170,592	171,000	179,500
Subtotal, recurring data collection	$ 643,141	$ 577,000	$ 605,800
Non-recurring R&D	8,353,144	9,667,400	10,394,200
Total, U.S. Antarctic Research Program	$ 8,996,285	$10,244,400	$11,000,000

In addition, the Operations Support Program subactivity provides logistics support to the following data collection programs:

- NOAA's global monitoring facility at South Pole
- USGS seismic monitoring at South Pole
- USGS satellite tracking at South Pole
- University of Texas satellite tracking at McMurdo

No U.S. Antarctic Research Program funds are used to support these efforts.

ARCTIC RESEARCH PROGRAM

In FY 85 you are requesting $8 million for your Arctic Research program. 12 Federal agencies are involved with Arctic Research.

Question: Could you please provide, for the record, a list of each of these agencies and the amount of money that each has put into the Arctic Research program in FY 83, and is planning to contribute in FY 84 and FY 85?

Answer: The agencies involved in Arctic research are: Departments of: Health and Human Services; Interior (United States Geological Survey, Fish and Wildlife Service, Bureau of Land Management, National Park Service, Minerals Management Service, Bureau of Mines); Defense (Army, Navy, and Air Force); Energy; Commerce (National Oceanographic and Atmospheric Administration); Transportation (United States Coast Guard, Maritime Administration); Agriculture; National Aeronautics and Space Administration; Environmental Protection Agency; National Science Foundation; Army Corps of Engineers (Civil Works); and Department of State.

Arctic research in many of these Federal agencies is not a budget line item, but rather it is an integral part of normal agency mission related research programs. These agencies have no separately identified arctic program, but sponsor meritorious research and develop projects regardless of geographic area. In an one fiscal year, a number of these projects may be defined as arctic research or cold regions research.

Some agencies do have separately identified arctic research programs, but even for these agencies, considerably more arctic research may be supported than the amount indicated under the separately identified arctic research program. For example, the National Science Foundation Arctic Research Program obligated $6.2 million in fiscal 1983, while other research programs in the NSF obligated $6.7 million for a total NSF arctic effort of nearly $12.9 million.

The table provides unofficial estimates of Federal agency obligations (FY 83) for arctic research or estimates of planned obligations for arctic research (FY 84 and FY 85). (No national security classified research is reported in these totals.)

UNOFFICIAL ESTIMATES

ARCTIC RESEARCH
FEDERAL AGENCIES
(In Millions of Dollars)

UNAUDITED DATA. IT IS INTENDED TO PROVIDE INFORMATION ON THE RELATIVE SIZE OF AGENCY PROGRAMS.

Agency	FY 1983	FY 1984	FY 1985
National Aeronautics and Space Administration	1.5	1.8	2.7
Health & Human Services	2.0	1.8	1.6
Department of Interior			
- Fish and Wildlife Service	1.4	1.4	1.6
- National Park Service	1.6	1.7	1.8
- U.S. Geological Survey	10.0	10.8	n.a.
- Burean of Land Management	1.5	1.3	n.a.
- Minerals Management Service	28.7	25.1	n.a.
U.S. Air Force	1.7	1.8	1.6
U.S. Army	11.3	13.0	14.2
U.S. Army (Civil Works)	2.9	3.1	3.3
U.S. Navy - Office of Naval Research	8.2	8.1	7.0

Senator Garn—Continued

Agency	FY 1983	FY 1984	FY 1985
Department of Energy			
- Fossil Energy	1.4	1.9	n.a.
- Environmental Biology	1.2	1.6	n.a.
National Oceanographic and Atmospheric Administration	6.4	7.0	n.a.
Department of Transportation			
- U.S. Coast Guard	0.2	1.4	0.2
- Maritime Administration	0.1	0.3	0.3
Environmental Protection Agency	0.5	0.4	0.4
National Science Foundation	12.9	15.0	17.0
Department of Agriculture	1.4	1.3	n.a.
Department of State	0	0	0

n.a. - Information not available

Question: What percent of the total Federal research support has been provided by NSF in each of the last five years?

Answer: Concerning the percentage of total Federal research support provided by NSF in each of the last five years, there has been no substantial change in the proportion of federal arctic research conducted by the various agencies.

It is estimated that the National Science Foundation has provided about 15% of the total Federal support for arctic research over the past 5 years. NSF support for basic research in the arctic is estimated to be 60% of the Federal total during this same time period.

ANTARCTIC PROGRAM

For FY 84 the Congress provided $102.1 million for your Antarctic Program. Included within that amount was $5 million for the life extension program for two of your oldest LC-130 aircraft. This year you are requesting an additional $5 million for that program. I understand that the first $5 million has not yet been obligated and there is some question as to whether it will be used for the purpose for which it was requested.

Question: Could you please bring us up to date as to the status of the life extension program and your negotiations with the Department of Defense relative to support aircraft?

Answer: The funds provided in FY 1984 for service life extension will not be used for any other purpose and will remain unobligated until some solution is developed by DOD. (These are "no year" funds).

Senator Garn—Continued

The problem of extending the service life of the two NSF-owned LC-130F aircraft remains unresolved. NSF has requested the Chief of Naval Operations to provide viable alternatives with regard to the disposition of the two LC-130F aircraft.

Two LC-130F aircraft were scheduled for SLEP in FY 1985 and FY 1986; however, new contract requirementes have escalated costs to the extent that other options of extending the service life of these aircraft must be examined. In order to keep these two aircraft in a operational status for the Antarctic Program, their service life must be extended.

Informal liaison with DOD indicates these options range from increasing the in-depth work required to refurbish present aircraft during Scheduled Depot Level Maintenance (SDLM) cycles to the recommendation for procurement of new aircraft.

Funds should be appropriated in FY 1985 to permit initiation of aircraft refurbishment once an acceptable solution is developed. Failure to have the funds available would delay initiation of the program for at least another annual budget cycle.

VERY LONG BASELINE ARRAY

Your FY 85 budget request $15 million for the initial construction cost for the Very Long Baseline Array Radiotelescope. I understand that the Astronomy Survey Committee of the Natioanl Academy of Sciences identified this telescope as the highest priority major new program for ground based astronomy in the 1980's. I further understand that the facility will represent an improvement in resolution by a factor of 100 to 1000 over conventional radio and optical telecopes.

The Spectrum coverage of this proposed facility overlaps considerably with the capability of the existing Very Large Array facility in New Mexico.

Question: What increase in resolution over that obtained by the Very Large Array will be achieved through the use of this facility?

Answer: The Very Long Baseline Array (VLBA) improves resolution by a factor of about 500 over the Very Large Array.

Question: Could you please provide for the record a detailed breakdown of the cost and schedule for the entire project by Fiscal Year.

Senator Garn—Continued

VLBA BUDGET AND COST ESTIMATE
($ in Thousands)

	1984*	1985	1986	1987	1988	TOTAL
Antenna Starts		1	3	3	3	10
Antennas, Bldgs. Project Management	1,260	7,450	11,150	8,200	9,500	37,560
Electronics	490	4,500	1,800	2,200	2,200	11,190
Control, Correlator, Data Processing	750	2,900	2,400	3,900	2,600	12,550
Systems Engineering, Spares, Misc.	0	150	150	1,200	1,200	2,700
TOTALS (85$)	2,500	15,000	15,500	15,500	15,500	64,000

The breakdown of the annual budgets is tentative. Detailed costing is a major objective of the design study* in FY 1984. Note: The $64 million total includes design. Construction is estimated to be $61.5 million.

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

This year you are requesting $45.92 million for support of the National Center for Atmospheric Research. This represents an increase of $5.92 million over what is planned for obligation during FY 84.

One of the largest areas where you show an increase is in Scientific Computing. You note that the Center intends to acquire an Advanced Vector Computer and additional mass storage capability. You also indicate that the total purchase cost for this computer is estimated to be $20 million and the FY 85 requirements are for $5 million.

Question: Can you please describe the nature of the system, the type of machine including the vendor, the review procedures that were used to identify the need for this additional computing capability, the funding schedule by fiscal year, and when you expect this system to be on line?

Answer: The Advanced Vector Computer (AVC) will become the centerpiece of the NCAR computer facility comprised of other computers, software systems and specialized user services. The AVC represents the latest advance in computer technology. It provides the greatest speed and largest central processing memory. The vendor has not been selected and will be determined after responses to an RFP have been received. Several vendors are expected to bid. It is probable that the AVC will have the following main features:

- A multi-processor system of 4-16 processor all having access to the same central memory and secondary storage. The software delivered with AVC initial systems may not support a very high degree of parallel processing, but software to achieve increased parallelism will be developed over time.
- A central memory of up to 128 million 64 bit words.
- Rotating magnetic storage with a capacity of 50-100 x 10^9 bytes in 10-20 physical drives.
- Appropriate interfaces to the mass store, the conventional magnetic tap system, and the primary input/output systems.

The scientific justification was based on need opinions and expressions of need received from more than 200 scientists across the country. Endorsements for this acquisition have been made by user conferences, advisory committees, and the National Science Board.

The funding schedule to acquire the AVC, which is expected to be on-line in mid-FY 1986, is shown in the following table:

(Millions of Dollars)

	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
Lease Purchase	$ 5.0	$ 7.5	$ 7.5	$8.4	$ -0-
Operation Cost	-	1.7	1.8	1.9	2.0

These costs include site preparation ($1.4 million) and interest costs associated with lease purchase.

Question: Will any of the existing computing facilities at the Center be phase out?

Answer: The NCAR AMPEX mass storage system will be phased out over the period FY 1986-1987. The future need and requirements for the two CRAY-1 computers that NCAR currently has will be determined after the AVC has been procured and becomes operational.

Question: Does any other agency intend to share in the cost associated with the procurement of this system?

Answer: No other agency intends to share these costs.

Question: Has any other agency shared in the procurement of prior computer systems, and if so to what extent?

Answer: No other agency has shared in the procurement of prior computer systems.

You indicate in your budget justification that reimbursements for use of the Center's computer and other services amounted to $1.911 million in FY 83.

Question: What is your expectation for FY 84 and FY 85?

Answer: The scientific and facilities programs at NCAR are a national resource. Often this Center represents the best capability to perform research or develop instruments of interest to other government agencies. If these tasks are consistent with the Center's mission, program and research objectives, NSF approval is given for proposals to be submitted to other agencies for funding of these efforts. Beginning in FY 1981 a policy was instituted to charge non-NSF agencies for all costs associated with these programs. These charges reimburse costs for staff salaries, benefits, facility services including computer usage, overhead, and provide for all incremental costs. A summary of these reimbursement costs for FY 1983-1985 is provided in the following table.

Summary of NCAR Reimbursement Costs

	FY 1983 (Actual	FY 1984 (Estimate)	FY 1985 (Estimate)
Staff Salaries/ benefits	$ 623,000	$ 467,000	$ 500,000
Facility services	412,000	478,000	511,000
Overhead	876,000	1,312,000	1,389,000
TOTAL	$ 1,911,000	$2,257,000	$2,400,000

VERY LARGE ARRAY IMPROVEMENTS

You note that during FY 85 the Foundation intends to improve instrumentation at the Very Large Array Facility. You indicate that such an improvement will result in an increased level of efficiency.

Question: Could you please describe the types of improvements you intend to make and what specific types of increases in efficiency you expect to achieve.

Answer: Major VLA improvements include new low-frequency receivers, atmospheric water vapor monitors, and added computing capability.

Question: Could you please identify whether these improvements are necessary due to design deficiencies in the original project, cost limitations imposed on the original project, or new technological developments.

Answer: The improvements are necessary due to technological developments and cost limitations on the original project.

ASTRONOMICAL INSTRUMENTATION AND DEVELOPMENT

Your current FY 84 operating plan includes $9.7 million for Astronomical Instrumentation and Development. For FY 85 you are requesting $8.23 million. This represents a decrease of $1.47 million from the FY 84 level.

Question: Could you please explain the basis for this decrease?

Answer: The decrease accompanies the transfer of the Haystack Observatory and of the Five College Radio Astronomy Observatory (University of Massachusetts) to astronomical science programs as they change from developmental to operational status.

FUNDING OF ASTRONOMY CENTERS

On page AAEO-I-2 of your budget justification you present a list of your national astronomy centers.

Question: Could you please indicate the level of funding that each of these centers has received from NSF and separately the amount of funding they have received from other sources, during FY 83 and the estimates for FY 84 and FY 85?

Answer:

FUNDING OF ASTRONOMY CENTERS

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Estimate
NSF			
National Astronomy and Ionosphere Center	$ 6,110,000	$ 7,200,000	$ 7,500,000
Kitt Peak National Observatory Cerro Tololo Inter-American Observatory National Solar Observatory	20,189,000	23,650,000	24,800,000
National Radio Astronomy Observatory	15,900,000	20,600,000	33,400,000
TOTAL	$41,199,000	$51,450,000	$65,700,000
Other Sources			
National Astronomy and Ionosphere Center	$ 315,000	$ 315,000	$ 315,000
Kitt Peak National Observatory Cerro Tololo Inter-American Observatory National Solar Observatory	830,419	901,000	736,000
National Radio Astronomy Observatory	842,800	621,100	652,000
TOTAL	$ 1,988,219	$ 1,837,100	$ 1,703,000

SPACE TELESCOPE

Our FY 84 report specifically cites some concerns about the need to coordinate NSF's and NASA's activities in the area of astronomy. Specifically the report states that the Committee, "is still concerned that the issue of the respective roles of NSF and NASA in astronomy has not been resolved. In particular, the Committee is concerned about the future of the space telescope. The Committee expects this facility to be available to the entire astronomy community through a broad-based peer review process. The Committee expects a joint NSF/NASA report on the process that will be used for the selection of principal investigators by March 1, 1984."

Question: What agreement did you reach with NASA relative to the role of the 2 agencies in using the Space Telescope -- for instance how will principle investigators be selected?

Answer: NSF and NASA have prepared a report to the Senate Appropriations Committee directly addressing its concerns. A copy of that report will be provided for the record.

Users will have access to the Space Telescope through a competitive peer review process conducted by the Space Telescope Science Institute and involving significant numbers of members of the astronomical community in the U.S.

Question: What proportion of the viewing time will be devoted to scientists performing observations in support of NASA missions?

Answer: The proportion devoted to scientists performing observations in support of NASA missions will be determined through the peer review process.

Question: Would you please summarize the agreement for us?

Answer: Space Telescope will be observatory available to astronomers throughout the world. Responsibility for science operations rests with the Space Telescope Science Institute, operated by the Association of Univesities for Research in Astronomy, Inc. for NASA. The Institute will develop the peer review procedures for allocation of observing time. Observers will be funded for expenses incurred in their approved research programs by NASA through the Institute.

Discoveries made with Space Telescope are expected to increase demand for ground-based observing time. Proposals to use the NSF-funded National Observatories will be subject to normal review processes at each observatory. Regular research proposals from scientists to investigate the implications of discoveries made with Space Telescope will be reviewed through the normal peer review process.

There is continual communication between the staffs of both agencies, and regular meetings are held to coordinate current activities and future planning efforts with regard to both ground-based and space-based projects.

Question: How have you modified your long term astronomy program plan in anticipation of the availability of the space telescope?

Answer: Longer-term planning in astronomy includes increased university research support, improved instrumentation at National Centers and university observatories to deal with the increased pressure expected when Space Telescope begin observations.

Question: Please submit a copy of the joint NASA/NSF study for the record.

Report to the Senate Appropriations Committee on the Selection of Principal Investigators on the Space Telescope

Report #98-152 which accompanied H.R. 3133 of the Department of Housing and Urban Development Independent Agencies Appropriation Bill 1984 had the following request:

> "...the Committee is concerned about the future of the Space Telescope. The Committee expects this facility to be available to the entire astronomy community through a broad based peer review process. The Committee does not intend to sit idly by while the astronomy program is fractionalized. The Committee expects a joint NSF/NASA report on the process that will be used for the selection of principal investigators by March 1, 1984."

This report is submitted in compliance with the request of the Senate Appropriations Committee.

The Space Telescope will be used as an observatory available to astronomers throughout the world. Data from the telescope will be received at the Goddard Space Flight Center and will then be transmitted to the Space Telescope Science Institute, which will have responsibility for science operations. The Institute is an independent science institute operated by the Association of Universities for Research in Astronomy, Inc. on behalf of the National Aeronautics and Space Administration (NASA). It is located on the Homewood Campus of Johns Hopkins University in Baltimore, Maryland. The Institute's Director is Dr. Riccardo Giacconi.

The science program conducted by the Space Telescope Science Institute will be done in such a way as to maximize the scientific usefulness of this space-based observatory. This approach is believed to be the best one to bring the user community in direct contact with and control of the science that is to be done with the instrument. The Space Telescope Science Institute will:

- o Establish the science program guidelines for the Space Telescope.
- o Select the Space Telescope observers and archival researchers.
- o Fund US user participation.
- o Provide direct technical support to observers before, during, and after their observations. These activities will be reviewed at least annually by NASA.
- o Develop an integrated observing schedule to be used by the Operations Control Center at the Goddard Space Flight Center.
- o Sponsor Space Telescope related research necessary for efficient use of the observatory.
- o Evaluate the scientific performance of the Space Telescope observatory and its individual scientific instruments and advise NASA on observatory status.
- o Process, archive, and publicize the scientific data derived with the Space Telescope, making this information accessible to the public.
- o Conduct a program to encourage visiting scientists.
- o Establish a scientific staff to perform the above functions and conduct their own research related to the Space Telescope.

Users will have access to the Space Telescope through a competitive peer review process. Announcements for the opportunity to participate in such a competition will be made every six months, and these announcements will be sent to all members of the U.S. astronomical community as well as to astronomers throughout the world.

The Space Telescope Science Institute will develop the peer review procedures for allocation of observing time on the Space Telescope. These procedures will preserve commitments that NASA has already made to principal investigators and other members of the Development Phase Science Team and those described in the NASA/European Space Agency (ESA) Memorandum of Understanding. It is understood that a significant fraction of the observing time must be provided to qualified scientists who are not connected with the Space Telescope Science Institute or the Development Phase Science Teams. The Space Telescope Science Institute scientific staff members are expected to participate actively in the use of the Space Telescope but they will be required to compete for observing time with other astronomers on the basis of scientific merit. There will be a balance between short- and long-term programs and targets of opportunity. The Institute will develop and implement the policy regarding the treatment and balance of the program. It is expected that the peer review system will involve significant numbers of members of the astronomical community in the U.S. After receiving the recommendations from the peer review panels the Space Telescope Science Institute Director will select the general observers.

U.S. scientists who have been selected as general observers will be funded in order to cover expenses incurred in their approved research programs. These funds will be provided by NASA through the Space Telescope Science Institute. Expenses will include such items as related travel, computer time, graduate student support, new software development for enhanced calibration or analysis of Space Telescope science data, and publications. Funding of scientists who are Federal employees will be subject to applicable government regulations.

The Space Telescope Science Institute will support Space Telescope observations by all users as well as user data calibration and analysis. The staff will become thoroughly familiar with the instruments and Space Telescope operations and capabilities in order that it will be able to:

1) interface with space telescope observers to provide current observation-related information to ensure the most efficient use of the instruments;

2) assist users in optimizing their proposed scientific programs; and,

3) promote and suggest correlated research programs of other space systems and ground observatories to obtain the best scientific return from the Space Telescope.

Discoveries made with the Space Telescope are expected to signficantly increase demand for ground-based observing time. The National Science Foundation (NSF) has lead agency responsibility for the support of ground-based astronomy. In fulfilling this responsibility, the Foundation provides operational funds for the National Observatories and provides research grants to scientists at universities. Proposals to use telescopes at the National Observatories to follow up on Space Telescope discoveries will be subject to the normal review processes at each observatory. In addition, the Foundation expects to receive regular research proposals from university scientists to use university-based telescopes to investigate the implications of discoveries made with the Space Telescope. It is the Foundation's intention to have such proposals reviewed through the normal peer review process.

The National Aeronautics and Space Administration and the National Science Foundation have consistently coordinated their efforts in the support of research in astronomy. Space-based instruments such as the International Ultraviolet Explorer, the High Energy Astronomical Observatory, and the Infrared Astronomical Satellite have provided significant new information on the universe about us. Throughout this period NASA and NSF have worked together to ensure that the community is involved in all aspects of the selection of principal investigators. NSF staff regularly participate in the selection process of users for various space observatories. There is continual communication between the staffs of both agencies, and regular meetings are held in order to coordinate current activities and future planning efforts with regard to both ground-based and space-based projects. It is the intention of both agencies to continue this active and very important cooperative effort, and to maintain close lines of communication with each other during the period prior to, during, and following the launch of the Space Telescope.

2/9/84

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Astrophysics Division
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Laura P. Bautz

Laura P. Bautz, Director
Division of Astronomical Sciences
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Senator Garn—Continued

MULTI-INVESTIGATOR OR MULTI-DISCIPLINARY PROJECTS IN THE MATHEMATICAL AND PHYSICAL SCIENCE

On page MPS-8 of your budget justification you note that "the number of multi-investigators or multi-disciplinary projects supported is increased, particularly in the basic engineering areas of materials research."

Question: How do you expect to accomplish this increase in these types of projects -- Does NSF intend to undertake a special solicitation for such projects?

Answer: The NSF is in the process of establishing a new program entitled, Materials Research Groups," in the Division of Materials Research. A brochure announcing this program is in preparation and will be issued in the spring of 1984.

Question: Could you please provide for the record the expected level of NSF funding for the General Social Survey, the National Election Studies, and the Panel Study on Income Dynamics, for FY 83 through FY 85?

	FY 1983	FY 1984	FY 1985
General Social Survey	$491,596	$ 556,091	$ 552,357
Supplement	16,445		
National Election Studies	494,693	1,575,249	997,367
Separate Planning Grant	81,697		
Panel Study on Income Dynamics	475,000	1,100,000	1,000,000

COGNITIVE SCIENCE AND SCIENCE EDUCATION

In FY 85 you are requesting $8 million for your cognitive sciences program. This represents an increase of $400,000 over the FY 84 level. Your budget justification outlines the general areas where these additional funds will be applied, however, there is no indication as to what proportion of the increase or the $8 million will be devoted to research that has direct relevance to your science and engineering education program.

Question: Could you please indicate for the record what percent of the cognitive sciences program and what percent of the other Biological, Behavioral and Social Sciences programs would have such applicability and the total estimated dollar value associated with those programs. Please provide the same information in reference to your FY 84 budget.

Answer: For FY 1985 approximately 75% ($300,000) of the requested increase for cognitive science and 40% ($3,200,000) of the total request is to be devoted to research of direct relevance to science and engineering education. The comparable figure for the FY 1984 current plan is approximately 34% ($2,600,000).

Senator Garn--Continued

In FY 1984, an additional $3,000,000 from science and engineering education funds is being spent on "Grants for Research on the Teaching and Learning of Science and Mathematics." The largest portion of this research will be in the cognitive sciences, with small amounts going to information science and technology, and to sociology.

Cognitive science information and technology, and sociology are the programs in the biological, behavioral and social sciences whose research is of relevance to teaching and learning in science and mathematics. Approximately 6% of the basic research in information science and technology has indirect relevance to science education (approximately $400,000 in FY 1984 and FY 1985). In sociology, approximately 8% of the awards in FY 1984 will be for research on social behavioral, and economic factors with direct relevance for science and engineering education; in FY 1985, an estimated 10% ($365,000) will be for research in this area.

SYSTEMATIC AND POPULATION BIOLOGY

On page BBS-II-10 of your budget justification you state that an increase of $3.54 million in your systematic and population biology program will be distributed among three activities.

Question: Could you please, for the record indicate what portion of the increase will be available for each of these activities and the total funding that each of these activities will receive during FY 85?

Answer: The increase of $3.54 million in the Systematic and Population Biology Program subelement, and the total estimated funding for each of the three specified activities during FY 85, is as follows:

(Dollars in Millions)

Activity	Increase	Total
1. Special equipment for molecular/ genetic approaches	$ 0.34	$ 1.34
2. Plant Biology	3.00	14.00
3. Refurbishment of marine laboratories	0.20	1.40
TOTAL	$ 3.54	$ 16.74

Senator Garn—Continued

ECOLOGICAL PROJECTS

On page BBS-II-8 of your budget justification you indicate that part of the increase in your biotic systems and resources subactivity will be devoted to "comparison of ecosystem dynamics among the 11 long-term ecological projects".

Question: Could you please briefly describe the purpose of each of these 11 projects, the total funding received from NSF, the grant recipient, and the expected completion date for each of these projects?

Answer: The primary basis for research on "comparison of ecosystems dynamics among long-term ecological projects" is that, despite obvious biotic and geographic differences among ecosystems, there are emergent shared characteristics as well. Such shared characteristics will center upon directions and magnitudes of response to natural and man-induced disturbances and in the abilities of ecosystems to maintain their character through time. Processes and phenomena of interest, such as plant community composition or soil fertility, change at rates and in directions that are discernible only over long time spans. Through coordinated and collaborative research on a representatively diverse array of ecosystem types a foundation can be laid in fundamental knowledge that will underwrite more enlightened decision-making on important natural resources.

Project	Total Funding (Through Ending Date	Grantee/ P.I.	Ending Date) Current Grant o
H.J. Andrews	$1,006,000	Oregon State Univ. Richard H. Waring	Jan. 1986

Research in this project addressed nutrient dynamics and biomass production in western coniferous forests with special attention being given to forest stand establishment, early growth and maturation.

o Cedar Greek	$1,345,000	Univ. of Minnesota G. David Tilman	Jan. 1987

Investigators are addressing especially the dynamics of native vegetation in relation to soil nutrient status, time since agriculture and in response to fire and grazing.

o Central Plans	$1,346,000	Colorado State Univ. William K. Lauenroth	Jan. 1987

Senator Garn—Continued

Project	Total Funding (Through Ending Date	Grantee/ P.I.	Ending Date) Current Grant o

Productivity of the shortgrass steppe ecosystems as a function of soil nutrients, water regime, and grazing are being investigated at the landscape scale in relation to soil formation processes.

o Cowetta	$1,349,000	Univ. of Georgia D. A. Crossley	Jan. 1986

Southern Appalacian deciduous forest ecosystems are the location of research on hydrology, geomorphology, and nutrient dynamics as determinants of forest tree production and ecosystem maintenance.

o Illinois and Mississippi Rivers	$1,348,000	Illinois Natural History Survey Richard E. Sparks	Jan. 1987

Major disturbances to large rivers (e.g. channel dredging, shipping traffic, exotic species introduction) are being studied as primary factors influencing change in river ecosystems (e.g. sediment dynamics, fisheries, water quality).

o Jornada	$1,345,000	New Mexico State Univ. Walter G. Whitford	Jan. 1987

Rainfall and soil nutrient status and the activities of herbivores and detritivores (e.g. termites) are objects of investigation as primary influences on the character of the Chihauhaun desert ecosystem.

o Konza Prarie	$1,331,000	Kansas State Univ. G. Richard Marzolf	Jan. 1986

True tallgrass prairie, once a dominant feature of the central U.S., is the base for study on the effects of native and domestic grazers, and the timing and severity of fire in maintaining ecosystem type and controlling its productivity.

o Niwot Ridge	$1,349,000	Univ. of Colorado Patrick J. Webber	Jan. 1986

Alpine tundra ecosystems and associated alpine lakes are being studied with special attention given to the effects of human activity, modern climate, and paleo-climate on maintaining or inducing changes in these systems.

o North Inlet	$1,350,000	Univ. of South Carolina F. John Vernberg	Jan. 1986

Senator Garn—Continued

Project	Total Funding (Through Ending Date	Grantee/ P.I.	Ending Date) Current Grant o

Research focuses on nutrient dynamics and plant, fish and wildlife productivity of a southeastern coastal marsh and associated maritime forest and estuary.

o Northern Lakes	$1,300,000	Univ. of Wisconsin John J. Magnuson	Jan. 1986

Research focuses on the bases for the biological and chemical similarities and differences among a suite of lakes of different size and shape all situated in the same glacial till geological region.

o Okefenokee	$1,357,000	Univ. of Georgia Bernard C. Patten	Jan. 1987

This swamp ecosystem is being studied as a diverse mosaic of habitat types characterized by different plant/animal associations interlinked by the surface and subsurface movements of water and nutrient elements.

BIOLOGICAL INSTRUMENTATION PROGRAM

In describing the $1.4 million proposed increase in your biological instrumentation program you state that it will "permit relatively large-scale, multiuser instrumentation to be provided to key groups of biological scientists."

Question: What specific equipment do you have in mind and where is this equipment located? Does this entail the establishment of additional national facilities or centers in FY 85?

Answer: Success in contemporary biological research depends on research instrumentation. Regular research grants typically can provide general use equipment for gas chromatography, electrophoresis, scintillation and gamma counters and high speed centrifuges. However, laboratories serving groups of biologists often require more costly equipment such as laser assembles, cell sorters, gene synthesizers, electron microscopes, nuclear magnetic resonance spectrometers, infrared, Raman and fluorescence spectrophotometers, and computers. Such multiuser instrumentation is provided by BIP to groups of biologists with meritorious research programs at U.S. universities. This program for multiuser instrumentation is highly competitive and does not entail national centers or facilities, but rather is responsive to instrumentation needs of groups of academic researchers in biology.

You further note that part of the increase will be used to provide additional computing capability.

Question: Could you please describe how much will be devoted to computer purchases and access during FY 84 and FY 85 and what percentage of this access will be supplied through the supercomputer centers?

Answer: In recent years, the greatest growth in instrumentation needs as reflected in proposals received has been for computers and computer graphics. Biology is moving into the computer age, but, for the most part, is not yet ready for supercomputers. Most of BIP's support of computer-related instrumentation needs will be multiuser applications of mid-level computers and associated graphics capability. Substantial supercomputers needs in biology have emerged to date primarily in Biophysics where modeling and x-ray crystallographic studies, for example, present a compelling need for access to supercomputers. It is anticipated that approximately $750,000 will be needed for supercomputer access by individual biologists during FY 1985, primarily in the Biophysics Program; BIP will spend an amount at least twice as large for the purchase of mid-level computers and graphics capability for groups of biological scientists.

PLANT DEFENSE MECHANISMS

Question: Please provide a brief summary of the NSF projects and the progress that has been made in the important area of plant defense mechanisms.

Answer: NSF is currently supporting about 100 projects dealing with plant defensive mechanisms. The following is a brief summary of some of the major findings.

It is now known that most species of plants have evolved chemical defense against herbivores. These chemicals can be generally classified as small molecular weight compound (toxins) which are poisonous to most consumers or larger molecules such as tannins which are not poisonous but form complexes with proteins in the guts of herbivores and reduce protein digestibility. The quality and quantity of these constitutive defenses change within an individual plant as leaf tissue ages. A new leaf has a high percentage of toxins which are poisonous to most insect species. As the leaf ages the percentage of toxins decreases, but the percentage of tannins increases. Researchers also are now finding high variation in these chemicals among leaves on the same tree and among trees of the same forest.

Not only are insects deterred by these chemicals but also some vertebrate herbivores. For example, researchers from the University of Alaska reported in a December 1983 issue of Science that snowshoe hares avoid parts of willow which are high in phenolic (a toxin) concentration.

Senator Garn—Continued

In addition to an abundance of these constitutive defenses, recently researchers have found that once attached by herbivores, a plant can almost immediately begin synthesizing high concentrations of secondary chemicals at the site of injury. It has also been found that after initial defoliation by insects, reflushed leaves are far more resistant to further attack. A new line of research which will become increasingly important is that these chemicals also apparently provide protection against pathogenic organisms such as fungi and bacteria.

Recently researchers have found that attacked trees produce airborne chemicals which are detected by other trees and result in their also building up chemical fortifications, e.g., the talking trees story which reached the news media last year. Researchers are trying hard to isolate this airborne chemical because of its obvious potential for integrated pest management. Nevertheless, despite all of these chemical defenses, specialized insects have evolved ways of either tolerating them or detoxifying them, so the question has been raised as to what keeps these populations of insects under control. The latest findings suggest that predators may keep herbivorous insect densities at low levels and that plants can evolve ways of making the most efficient use of these predators. For example, many species of plants secrete nectar which is fed upon by ants; and the ants, in turn, kill and eat all herbivorous insects they find on the plant.

Although great progress has been made in the last few years in discovering defensive mechanisms of plants, new discoveries continue to be made. For example there is a species of tropical vine which produces leaf appendages that look like butterfly eggs. The female butterfly when searching for a place to lay her eggs will avoid these vines because she perceives another female has beaten her to the spot; thus the vine is protected from young butterfly larvae.

The research in this large field of plant defensive mechanisms is intensive and highly competitive because many of the discoveries will eventually have wide applicability in forestry and agriculture for the control of plant pests and pathogens.

INFORMATION SCIENCE

I understand that NSF is the only source of non-mission Federal support for information research and furthermore that you are the major support of multi-disciplinary research on information science.

Question: What implications does the information sciences program have for advances in electronics and computing machinery?

Answer: The program deals with several topics relevant to the design and application of computing machinery. These include the representation of knowledge, the understanding of information-bearing forms of communication, such as languages, vision, mathematical symbols and patterns, and the processes for using them. A portion of the activity is devoted to understanding the economic and behavioral consequences of applications of computers.

Question: Could you please explain the importance of your information science program -- that is what types of fundamental studies are being conducted?

Answer: Even though it is a small program it is important because it is the main source of support for a newly emerging scientific field. It organizes its problems in a different way than older cognate sciences, using information as a central concept, seeking to understand it for its own sake as well as for the improvement of computers and communications devices, and for its role in economic and social processes.

The following types of fundamental studies are supported:

1. mathematical models of uncertainty which augment older concepts of probability, entropy, fuzzy sets;
2. the representation of information in humans and machines;
3. the way information is structured in processes of pattern recognition, usage and text processing;
4. general principles of information system design;
5. user-system interfaces;
6. the economics of information; and
7. the societal impact of information technology.

Question: On what basis did the Foundation decide to allocate the smallest dollar and percentage increase to information sciences and technology within the entire Biological, Behavioral, and Social Sciences?

Answer: Information Science is an emerging discipline. While the field has been slowly growing, the Foundation has maintained constant level of support in a continuing effort to nurture this new inter-discipline. The budget in IST has grown from $5.2M in FY 82 to $6.1M in FY 84 with an FY 85 request of $6.6M. This represents an increase of 27% in the four years from FY 82 to 85. Given competing demands of other high priority areas of research support, the decision was made to increase IST by 8%; although this represents the lowest percentage increase in the BBS directorate, this still represents real growth in the division.

AUTOMATING THE OPERATION OF A WASTEWATER TREATMENT PLANT

On page ENG-III-3 of your budget justification you describe a research project at the University of Houston which involved the computer simulation of a wastewater treatment processing plant.

Question: Could you please provide a brief description of this project for the record and indicate what support, if any, was provided for this effort by the Environmental Protection Agency?

Answer: The project described on page ENG-III-3 was initiated as a three-year NSF Continuing Grant in FY 1979 to the University of Houston with Dr. John Andrews as the Principal Investigator. The project was shifted to Rice University in 1982 when Dr. Andrews assumed his current position there as Professor of Civil Engineering. The NSF-supported project was a basic, mathematical modeling study exploring the complex chemical, biological and physical interactions that occur in the activated sludge process of wastewater treatment in the hope that this approach would lead to control strategies for the process that would accommodate and allow for the dynamic behavior of this process. His initial work led to a cooperative project, funded by the City of Houston in which concepts emerging from Dr. Andrews' research could be applied in a full-scale City of Houston treatment plant. The final increment of the NSF Continuing Grant was made to Rice University on April 2, 1982 with an expiration date of January 31, 1984.

The Environmental Protection Agency through its Municipal Environmental Research Laboratory in Cincinnati has maintained an interest in the instrumentation aspects of the City of Houston's cooperative project which has involved support of an instrument technician's time and travel expense through the Laboratory's Technical Assistance Program to municipalities. The technician involved has also contributed personnel, leave-time to the interface between the NSF-supported research and the City of Houston's interests. The Environmental Protection Agency is likely to exhibit further interest in the future development and demonstration of concepts that arise from these cooperative projects should the investigator's theoretical approach continue to exhibit validity through its full-scale application at Houston.

INCREASED FUNDING FOR SEPARATION PROCESSES

In FY 84 you requested $2.33 million for separation processes within your chemical and process engineering subactivity. In your operating plan for 84 you reduced this to $2.2 million. Now in your 85 proposal you have increased that this area of research to $3.44 million. This represents a 56% increase over the 84 level.

Question: Why did you decide to decrease the funding for this program in your operating plan if you had anticipated such a large increase in FY 85?

Answer: Budget increases reflect our perception of the importance of various areas at the time of budgeting and are a vehicle to lead or attract more activities into certain areas. However, the research community does not always follow quickly enough with proportional increases in "proposal pressure" because normally it has only 6 months to react to budget initiatives. Thus we make minor adjustments in actual allocations so as to assure optimal use of funds vis-as-vis other areas if proposal pressure either exceeds or lags behind budgeted amounts. Also, situations may have changed during the 18 months between budget and current-plan times.

As for the large increase between FY 1984 and 1985, part of it is due to the impending transfer of solid-liquid separation activities from the Particulate and Multiphase Process Program. But more importantly because separation/purification processes are so crucial to biochemical and energy technologies, we feel that a restatement of its importance through a substantial budgetary increase is warranted. Sometimes the community needs repeated prodding before they feel confident enough to move into new areas.

Question: What specific activities in this program are of such scientific or practical interest that they merit such a large increase?

Answer: Examples of specific activities include supercritical solvent extraction, novel membrane fabrication techniques, high-purity large-scale purification of products of recombinant DNA technology, and development of strategies for hybrid separation processes.

For FY 85 you are requesting an increase of approximately $12.1 million, or 15% in your chemistry subactivity. In justifying the need for this increase you cite a "plan" that has been developed to address important infrastructure issues in undergraduate institutions in order to encourage more students to pursue doctoral education programs in chemistry.

Question: Could you please describe the nature of this plan and specifically what NSF intends to accomplish over each of the next several years relative to this "plan"?

Answer: Stimulation of research in undergraduate institutions by support of faculty and undergraduate students will provide the educational environment conducive to career choices in chemistry. Within the total budget request for chemistry in 1985, provision is made for the support of research at primarily undergraduate institutions which is increased by $610K over the 1984 level of $4,164M, an increase of 17 percent. This support consists of four interrelated components.

- Regular Scientific Research Project Support Projects - $1.89M.
- Two- and Four-Year College Instrumentation Support -$1.2M.
- Research in Undergraduate Institutions (RUI) awards will support salaries, materials and supplies, and equipment for faculty and undergraduate students involved in research projects either at their home institution or at well-equipped host laboratories - $600K.
- Research Opportunity Awards (ROA) will support summer or sabbatical year research experiences for undergraduate chemistry faculty, which they will later share with students at their home institutions - $478K.

Senator Garn—Continued

PROBABILISTIC ALGORITHMS

Question: Could you please describe the implications of the Foundation's supported research in probabilistic algorithms?

Answer: NSF has been supporting research in what is known as probabilistic algorithms since their independent discovery in 1974 by Michael Rabin and Robert Solovay. Their importance lies in the fact that probabilistic algorithms are frequently faster than normal deterministic algorithms. The speed does not come free -- there is a tradeoff between certainty of an answer and the speed for obtaining that answer. For many applications, certainty is not a requirement - the only requirement is that the algorithm fail infrequently. Many of these applications involved the communications between collections of computers. Since such systems are becoming increasingly common, the study of probabilistic algorithms is taking on increasing importance.

Question: What level of support is the Foundation providing for this area of research in FY 83, FY 84 and FY 85?

Answer: The NSF support for probabilistic algorithms amounted to approximately $400,000 for 6 research projects in the Theoretical Computer Science program for FY 1983. Support levels for FY 1984 and FY 1985 are anticipated to be about the same.

DESCRIPTIVE METHODS IN STATISTICS

In describing some of the major programmatic topics within your Mathematical Sciences subactivity you discuss new advancements in the display of complex visual and graphic materials.

Question: Could you please provide an estimate of the level of support for these types of projects in FY 83, FY 84 and FY 85?

Answer: The visual display of complex mathematical structures has become a major tool in the conduct of research as advances in computational and graphics equipment made it possible. Statistics led the way in this effort; geometry and applied mathematics have been quick to follow; and other areas of the mathematical sciences are beginning to recognize the value of these tools. The table below gives estimates of obligations in support of projects with substantial graphics components.

(In Thousands of Dollars)

	FY 1983	FY 1984	FY 1985
Statistics	$ 425	$ 700	$ 800
All mathematical sciences	900	1,450	1,750

Senator Garn—Continued

PHYSIOLOGICAL, CELLULAR, AND MOLECULAR BIOLOGY

During FY 85 you expect to receive 5,752 proposals in your Physiological, Cellular, and Molecular Biology Program. During that year you expect to fund 1515 of these proposals. This means that only 26% of the proposals will be funded.

This is a considerably lower ratio than exists in most of the other program areas.

Question: Does this imply that these proposals are of lower quality, or this area of research is of lower priority, or that sources of funds other than NSF are available for the support of this research?

Answer: The PCM Division has historically had a relatively low success ratio of between 25-30%. Many very good projects are consequently not able to be funded; those that are supported have too often not been funded at optimal levels in order to "stretch" the limited support available. Proposals considered within the PCM Division are decidedly not of lower quality than in other program areas in NSF. Scientific opportunities in fundamental biology are more compelling today than in the past. The scientific opportunities in the areas covered by the PCM Division have grown faster than has the PCM budget over the past decade, causing the present distress. It will take time and substantial growth to address these needs more adequately.

Although there are substantial opportunities for the support of biomedially relevant research by the National Institutes of Health and for agriculturally relevant research by the U.S. Department of Agriculture, many biologists oriented toward the study of basic mechanisms depend on NSF for support. In contrast to the mission agencies, NSF maintains an "open door" to all biologists interested in fundamental research and receies many proposals for research undertakings.

INFORMATION PROCESSING AND BIOLOGICAL ORGANISMS

In your budget justification you describe some of the major programmatic topics being studied within your Information Science and Technology subactivity. One of those was application of models of information processing and biological organisms, including man to artificial information systems.

Question: Could you please describe the importance of this research and some of the recent research findings in this area?

Answer:

Importance

Biological organisms at every level of complexity are still far more advanced than computing machines in their ability to form useful categories based on limited and noisy information. It seems useful to attempt to understand them in a way sufficiently general that the understanding could be applied, not just to today's limited machines, but to future man made information processing systems which may not be limited to serial digital operations.

Recent Findings

- Richard Herrnstein, at Harvard University has demonstrated that humans, pigeons and monkeys appear equally able to recognize object categories. This suggests that categorization is less dependent on brain size than had been believed. By studying relatively small nervous systems, it may be easier to isolate the categorization algorithms compatible with computational limits or conditions found in man made information processing machines.
- John Flowers, University of Nebraska, investigated the processes by which people isolate specific objects in visual fields. He documented an interaction between the patterns (edges of contiguous objects) and the temporal sequence in which objects are seen as critical factors in recognition, strongly supporting the thesis about the need for parallel processes in visual computation.
- Research still underway at MIT has shown strong similarities between the cortical control of arm motion by humans and algorithms for the efficient manipulation of robot "arms."

Question: What level of funding has the Foundation devoted to these modeling studies in FY 83 and what is the anticipated level of funding in FY 84 and FY 85?

Answer:

Level of Support

The Division of Information Science and Technology supported 5 projects, expending about $340,000 in 1983. Similar levels of support are expected in 1984 and 1985.

Question: What percent of the total federally supported work in this area is funded through the Foundation?

Answer:

Proportion of Support

NSF provides about 80% of the Federal support for work in this area. Funding for related work via the Department of Defense research agencies has varied sharply in the past several years. Based on the number of inquiries from scientists who have had support from those agencies, it appears that less support is available for basic research (not aimed at a target application) than in prior years.

OCEANOGRAPHIC FACILITY SUPPORT

Your budget justification for the Oceanographic Facilities support program indicates that you are developing "a long range plan to determine scientific requirements that will drive future facilities needs."

Question: Could you please outline the major features of this plan and the planning assumptions?

Answer: The Oceanographic Facilities Support Long-Range Plan is an integral part of the long-range planning process in the Ocean Sciences Division. Two key features of this plan are its coordination with the planning process of other Fedeal agencies involved with ocean science facilities and its responsiveness to perceived scientific requirements as identified by the academic ocean sciences community.

Ongoing coordination with other Federal agencies occurs with interactions with the Federal Oceanographic Fleet Coordinating Council (FOFCC). NSF is an active participant of FOFCC activities which presently include a study and internal review of ocean programs supported by each member agency (NSF, NOAA, Navy, U.S. Geological Survey, Coast Guard, Dept. of Energy, EPA) that is involved with ocean data collection, marine engineering and resources research. The current and future ship facility requirements to carry out the mission of each agency will be addressed as will plans to meet these requirements. The FOFCC study is scheduled to be completed in the summer of 1984 and results from that multi-agency review will be integrated into the NSF ocean facilities long range plan.

Further integration of scientific requirements into the facilities plan comes from advice received from the University-National Oceanographic Laboratory Sysem (UNOLS) and from the Advisory Committee for NSF of Ocean Sciences. UNOLS is an association of universities and research institutions involved with ocean science research; the membership includes a cross section of large and small facility operators and users. NSF receives periodic advice from both of these organizations concerning scientific requirements based on perceived trends and directions for ocean science research. Additionally, UNOLS has embarked on a study specifically addressing the future facility requirements of the academic research community. This study will address the age and composition of ships in the academic fleet and the requirements to effectively replace certain aging and inefficient vessels to meet ocean science requirements. This study is just getting underway and will not be available until mid-1985.

The facilities plan makes three broad assumptions. The first is that scientific reqirements drive facility needs. While it is difficult to forecast research developments and progress, facility planning must reflect the best advice and recommendations available on what types and numbers of facilities future science will need. The second assumption is that the present academic research fleet is aging and certain vessels will require replacement by the end of this decade. Of the 25 vessels presently in the fleet, 18 are more than 10 years old and three are more than 20 years old. Apart from the increasing costs of operating and maintaining elderly ships in a safe and productive manner, ocean science has advanced since these ships were designed. Their outmoded laboratories and equipment handling gear limit their scientific capability. The third assumption states that future scientific requirements for ships and facilities will differ somewhat from present ones. New technologies such as remote sensing of ocean parameters and fiber optic cables will change the configuration and equipment of future research vessels. These assumptions only emphasize the importance of a long-range plan to be responsive to planned and perceived scientific equipment needs.

Question: Could you please indicate the current status of the plan and when you expect the plan will be completed?

Answer: The long-range planning process at NSF is a dynamic and evolving process. The plan at any one time represents the amalgamation and integration of results and advice received up to that point. Two key elements of the facilities plan are being prepared. The FOFCC report, due in the summer of 1984, addresses the coordinated requirements of all Federal agencies involved with the ocean science enterprise. The UNOLS report focuses on those requirements of the academic ocean science community, and this report is anticipated in 1985.

Question: Could you please submit a copy of the completed plan to the Subcommittee?

Answer: The key element reports and the plan will be available to the Committee when completed.

OCEAN DRILLING PROGRAM

For FY 85 you are requesting $27.6 million for your Ocean Drilling Program. You expect that this amount would be augmented by $10 million contributed by foreign participants.

Question: Could you please describe the status of this program since our hearings last year?

Answer: Based on strong recommendations from the scientific community, NSF decided to pursue a long-term international program of ocean aimed at pursuing the same broad scientific objectives as the Deep Sea Driling Project (DSDP), but with enhanced technical capabilities. During FY 1984, much of the transition to the Ocean Drilling Program (ODP) has been accomplished:

- DSDP operations have been terminated: CHALLENGER has been demobilized and returned to her owner; contracts are being phased out; scientific activities are being completed.

- New management structure has been established paralleling other large-scale facilities operations; Joint Oceanographic Institutions, Inc., has become prime contractor; Texas A&M University has been named Science Operations Contractor.

- Drillship has been leased; Texas A&M conducted major competitive procurement; SEDCO 471 has been leased on highly favorable terms from 5 to 15 years, at NSF option; ship provides roughly double scientific work space and vastly enhanced technical potential including riser capability.

- Startup is underway; ship laboratory design is in process; limited conversion will begin early fall; shakedown and testing in November-December; initial science operations to begin January 1, 1985.

Question: Could you please list the specific agreements that have been concluded with various foreign countries and the amount of contribution expected from each?

Answer: During the transition period, a mixture of Memoranda of Understanding (MOU's) are in place. The goal is to increase international support from historic 25 percent to nearly 50 percent of operation costs. Immediate goal is 4 or 5 full memberships in place by FY 1985; 5 or 6 by FY 1986.

- MOU's for DSDP are still in force during FY 1984 and include closeout funding for DSDP are still in force during FY 1984 and include closeout funding for DSDP contracts totaling $1.2M. Countries involved are the Federal Republic of Germany, France, Japan, and the United Kingdom.

- "Candidate MOU's" provide $200,000 each toward FY 1984 planning costs are as follows: the U.K. signed 8/83; Canada signed 10/83; European Science Foundation Consortium (Italy, the Netherlands, Norway, Sweden, Switzerland) signed 3/84; Japan plans to sign 5/84; and France and FRG will cover candidates dues in regular MOU (below).

- Full member MOU covers a 10-year commitment in principle, $200K for FY 1984, and $2.5M per year for basic operations support. The status is that the FRG has signed an MOU in March, 1984; Franch is near approval with signing proposed for spring 1984; the U.K. is seeking Cabinet-level approval with signing in June/July probable; Canada has requested Cabinet-level approval and may enter in consortium with European group or Australia/New Zealand with a June/July decision likely; formal negotiations with Japan have just begun and, though the likelihood of approval is high, it may not occur until FY 1986; finally, formal negotiations with European Consortium began 12/83.

In the past the Foundation has received funding for their drilling program from other U.S. agencies.

Your current budget plan for FY 85 does not anticipate such funding.

Question: Can you explain why you do not expect to continue some of these cooperative arrangements in FY 85?

Answer: The only interagency funding for DSDP was reimbursement from the Defense Advanced Research Projects Agency (DARPA) for a particular experiment carried out on CHALLENGER over a 3-year period.

ODP is open to proposals from other U.S. agencies, but they must be screened and accepted by the full international science planning structure, and funded under ad hoc arrangements.

A number of scientists from other Federal agencies, particularly U.S. Geological Survey, the Smithsonian Institution, and the National Oceanic and Atmospheric Administration, have been active as individuals in the ocean drilling planning structure and on occasion, as shipboard scientists.

UNDERGRADUATE COLLEGE RESEARCH SUPPORT

Another initiative that you are undertaking during FY 84 is your Undergraduate College Research Support Program. Your FY 84 and FY 85 justification states that funds would be directed to those colleges that do not award Ph.D., but, provide many graduate students for our Nation's universities.

Last year you noted that funds for essential permanent equipment will also be provided. I asked how much would be available for such equipment and what type of equipment would be purchased. At that time you did not have the program defined in sufficient detail to answer those questions.

Question: Can you answer them now?

Answer: As the table shows, total support for predominantely undergraduate institutions in FY 1983 was $28.9 million. Of this total, $4.6 million was for research instrumentation. In FY 1984, our efforts will ensure that a minimum total of $36.8 million, including at least $5.0 million for equipment, will go to such institutions. Both amounts are expected to increase in FY 1985 to a total of $42.4 million, with $5.6 million for equipment. The exact nature of this equipment will depend on the particular research project, and the particular field of service or engineering.

Senator Garn—Continued

PRESIDENTIAL YOUNG INVESTIGATORS

During FY 84 you initiated a program entitled "Presidential Young Investigators Research Awards" you requested $6 million for that program in FY 84. Your current FY 84 plan calls for the allocation of $11.9 million to that program.

Question: Why did you find it desirable to essentially double the amount applied to the program, above the amounts requested during FY 84?

Answer: The procedure for calculating the average award size and the total award amount was revised upward, due mainly to higher matching estimates for industry and therefore, correspondingly higher contributions from NSF.

In FY 85 you are requesting $23.8 million, approximately doubling the FY 84 plan. This will allow the Foundation to support 400 Presidential Young Investigators in FY 85. You estimate that 200 of these will be new awards and 200 will be ongoing awards initiated in FY 84.

Question: Since you anticipate that the award period can be up to five years does this imply that we can expect this program to grow to close to $60 milion annually?

Answer: All awards are 5-year continuing awards, with only the cost for the first year provided in FY 1984.

Question: Could you please provide for the record the selection criteria that are used to identify Presidential Young Investigators and the characteristics of the recipients and their research in FY 84?

Answer: Presidential Young Investigators are evaluated and selected on the basis of ability and potential for contributing to the future vitality of the Nation's scientific and engineering effort as evidenced by original research, letters of recommendation, suitability of the sponsoring institution for the investigator's research and academic career, probable impact of the award on the future career development of the investigator, scientific quality of the research likely to emerge, and potential impact of the award on the research field in question.

The FY 1984 Presidential Young Investigators can be characterized as follows:

- 50% engineers, 30% mathematical and physical scientists, 12.5% biological scientists, and 7.5% astronomical, atmospheric, earth and ocean scientists;
- 10% female;
- Average span since Ph.D. - 4 years, including time for postdoctoral study in many cases;
- Associated with 74 universities in 35 states.

In FY 1984 Presidential Young Investigators are undertaking a wide variety of basic research projects, with engineering and other experimental activities predominating.

SUPPORT FOR GRADUATE STUDENTS ON RESEARCH AWARDS

For FY 85 the Foundation is proposing an increase of 15.5% in the funds available to support graduate students working on research grants. This represents an increase of 1,050 graduate students that can be supported.

Question: What proportion of the 15.5% increase will be used to support additional graduate students and what proportion will go to increasing the average support provided for each graduate student?

Answer: About 64% of the increase of $13.9 million, or $8.9 million, will be used to support additional graduate students and about 36% of the increase, or $5.0 million will be used to increase the average support per student.

COST PER GRANT

In FY 83 the average grant awarded by the Foundation was for $93,300. In FY 84 this is expected to increase to $109,300 and in FY 85 to $119,800.

Question: Could you please explain the major reason for these increases?

Answer: These averages summarize a number of adjustments which have been made in all of the Foundation's activities. Direct costs, such as travel and faculty and staff salaries, have increased and are expected to increase further in FY 1985. In particular, many universities have increased salaries for engineering faculty during this period.

In addition to such general increases, the Foundation has committed itself to increased support for graduate students in most programs. Furthermore, all programs have placed an emphasis on research instrumentation -- one of the most costly factors in high quality research, especially when support staff is included, as it often must be if the equipment is to be properly utilized. There have also been programmatic shifts. In FY 1985, for example, we are proposing a $10.0 million initiative for cross-disciplinary research centers in engineering. Since we anticipate making only five or so awards, each will total over $1.0 million. Likewise, awards in the Advanced Scientific Computing initiative will probably be considerably larger than average.

When each of these adjustments is summarized, they result in increases in the average size of awards in the Foundation as a whole.

Senator Garn—Continued

PROPOSALS AND RESEARCH DATA SUMMARY

Page QDT-2 of your budget justification contains summary data on your proposal activity, research funding and science and engineering education activities.

Question: Could you please, once again, correct the second centerheading in that table to read "Science and Engineering Education Activities" and include the table for the record?

Science and Engineering Education Activities

Personnel and Other Award Factors

Professional Staff Costs	$ 655,135	$ 28,952,490	$ 23,189,320
Other Staff Costs	414,450	5,679,360	4,560,970
Subtotal, Staff Costs	1,069,585	34,631,850	27,750,290
Expendable Supplies & Equipment	96,445	2,189,840	1,694,833
Permanent Equipment	-0-	3,400,000	2,700,000
Other Project Direct Costs	263,248	3,465,587	4,478,101
Subtotal, Nonstaff Project Costs	359,693	9,055,427	8,872,934
Total, Direct Costs	1,429,278	43,687,277	36,623,224
Indirect Costs	560,625	17,504,320	14,026,776
Participant Support Costs:			
Stipend & Other Personal Allowances	8,923,578	20,401,300	17,982,010
Cost-of-Education Allowances	5,173,089	7,320,533	7,067,990
Total, Participant Support Costs	14,096,667	27,721,833	25,050,000
TOTAL	$ 16,086,570	$ 88,913,430	$ 75,700,000

Senator Garn—Continued

SCIENTISTS AND ENGINEERS IN THE 1980's

Question: Could you please provide for the record, your current estimate of the supply and demand for scientists and engineers by discipline for the decade of the 1980's?

Answer:

Current Situation

- In 1983, nearly 60 percent of private industry firms that responded to a special NSF survey reported that it was easier to hire scientists and engineers during the 1982-83 recruiting year than in the previous two years.
- For no field of science or engineering, regardless of degree level, did as many as 10 percent of the firms indicate that they were experiencing shortages.
- Demand was expected to increase during the 1983-84 recruiting year. Industrial employers reported that new hires were expected to be equal to or greater than 10 percent of current employment levels of computer engineers, electrical/electronics engineers, manufacturing engineers, and computer scientists.

Projected Supply/Demand Balance, 1982-87

- A 1983 NSF study of the science and engineering labor market over the 1982-87 period assessed supply/demand balance by evaluating four requirement scenarios based on varying levels of defense spending and overall macroeconomic activity. The maximum range of requirements was determined by one scenario that assumed annual growth of defense expenditures of 3 percent and real gross national production (GNP) growth of 1.6 percent and a second that assumed an 8 percent growth in defense expenditures and a 4 percent growth of GNP.
- In general, the supply of scientists and engineers under all scenarios was projected to be adequate to meet employment requirements. The exceptions, where possible shortages are projected, are computer specialists and aeronautical/astronautical engineers. Electrical/electronics engineers could be in short supply under the high defense expenditure scenario.

MINORITY AND WOMEN PROGRAMS

Question: How much are you requesting in your budget for your Minority Research Initiation Program and your Visiting Professorships for Womens Programs during FY 85 and how does this compare to your FY 84 level?

Answer:

	FY 1984	FY 1985
MRI	$ 2.5M	$ 2.5M
VPW	$ 2.0M	$ 2.0M

"CREATIVE FINANCING" OF RESEARCH FACILITIES AND EQUIPMENT

Two years ago I asked the Foundation what it was doing to encourage State and Local Governments as well as universities to explore new and creative ways of financing equipment. You responded that the Foundation had been looking into the advantages and pitfalls of various techniques and had begun to encourage more thinking about the matter by carrying on a series of discussions with members of research community. I also asked whether NSF intends to collect and disseminate examples of successful financing programs. In response, you stated, "the idea of disseminating examples of successful cases is a good one and we will pursue it".

Last year you indicated that you had not yet taken any steps to widely distribute any such examples of the successful use of creative financing.

Question: Have you done anything since last year to disseminate such information?

Answer: The Foundation is supporting a major study of alternative financing techniques for, and better ways to manage, research equipment. The study is being undertaken by the American Association of Universities, in cooperation with the National Association of State Universities and Land Grant Colleges and the Council on Government Relations. It began in the fall of 1983 and will cover the following topics:

- the use of debt financing to purchase equipment;
- how to improve the procurement, management and maintenance practices of universities with regard to research equipment;
- how to increase private sector support for such equipment through tax incentives and manufacturers' donations;
- identification of budgetary and policy barriers at the institutions themselves and at the State level;
- identification of opportunities for change in Federal regulatory and budgetary policies and practices.

You also stated in FY 83, that, "the Foundation's Office of Planning and Resources Management will undertake to develop, or fund the development by others, of a guide that describes some of the techniques with case histories."

Last year you indicated that this project was not being pursued.

Question: What is the current status of this project?

Answer: This effort is being financed by NSF and five other Federal agencies (DOD, NASA, USDA, DOE, and NIH). Study participants will share their findings at a series of meetings of scientific and professional societies this fall. By early 1985, they expect to produce a guide to these subject, including case histories.

Last year I also questioned you about the potential impact of Section 222 of the Economic Recovery Tax Act of 1981, which permits an increased deduction for manufacturers who donate scientific research equipment to institutions of higher education. In response to that question you noted that the results of a joint OMB and Foundation review of the effects of Section 222 were not yet available.

Question: What conclusions can you share with us at this time?

Answer: Two years ago, OMB requested us to look into the effects of Section 222 of the Economic Recovery Tax Act of 1981 (ERTA). Last year we reported to you that we did submit findings to OMB from our early look at the effects of Section 222. Those findings were that there was some movement toward increased deductions for manufacturers' donations of scientific equipment, plausibly as a result of Section 222 of ERTA. We have done no further work on the effects of Section 222. But the latest annual survey done for the Council for Financial Aid to Education on corporate giving showed a sharp increase in donations of equipment to universities for the year 1982. Conversations of the Council with industry executives indicated that the incentive introduced by ERTA was an important factor.

INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTERS

In describing your Industry/University Cooperative Research Center program you state that about 14 centers will continue to be co-funded during FY 85 and that an additional 5 centers will be intitiated. You also note that about a dozen planning grants will be awarded to study the feasibility and viability of new centers. I note that the Foundation requested $3 million for this program in FY 84 and you are again requesting $3 million for the program in 85.

Question: Is it the goal of the Foundation to maintain this level of funding in the future and if so are you creating centers at the appropriate rate so that the private sector can contribute the additional costs necessary to assure that each of these centers is viable?

Answer:

- The goal of the Foundation is to maintain the annual funding of the centers program at around $3 million, adjusting for inflation.
- Increased visibility and success of the program is allowing NSF to reduce its per-center run-out costs and conversely to increase overall industrial support.

Senator Garn—Continued

- By 1988, the center program should reach a steady-state condition whereby during any one year, 5 new centers will become operational at an NSF cost of $500,000; 5 existing centers will become self sustaining at no cost to NSF; 20 centers will contine in an intermediate stage at an NSF cost of $2,000,000; and 10 centers will receive planning grants at an NSF cost of $500,000; for a total cost of $3,000,000/year.

- The average yearly support for each operational center is projected in 1988 to be $100,000 from NSF and $400,000 from industry and, for each planning grant, NSF will provide $50,000.

- Areas of research and technology being considered for the 5 new centers initiated in FY 1985:

-- Biotechnology
-- Electronics
-- Material Testing
-- VLSI/Sensor Integration
-- Steel Making/Basic Industry

Question: Will you please list the areas of research and technology that you are considering for the 5 new centers that may be initiated in FY 85?

OPERATIONAL CENTERS

Massachusetts Institute of Technology (self sustaining - no NSF funding)

Research on the constitution and forming of polymer and composite structures

Rensselaer Polytechnic Institute (Fourth of five years of NSF funding)

Research to improve the productivity of engineering design; studies in graphic and geometric modeling; development of a geometric data base; finite element graphics studies

University of Massachusetts (Fourth of five years of NSF funding)

Network polymer studies extended lifetime polymer studies; studies of diffusion and foams; chemical modification of surfaces and interfaces

Ohio State University (Fourth of five years of NSF funding)

Sensing variables for robotic arc welding; weld pool solidification studies; laser and laser-arc welding studies; study of of weld strength of steel structure; welding, discontinuity analysis; resistance welding control; micro joining; steel weldability

Case Western Reserve (Third of five years of NSF funding)

Studying the relationship between polymer properties and microstructural phenomena; current projects address glass-fiver reinforced thermoplastics, "liquid crystalline" thermaplastics, synthetic microfibrils, and the polymer gel state

University of Rhode Island (Second of five years of NSF funding)

Research on integrated robot system to develop a data base for industrial applications such as vision systems for robot control and inspection, integration of robotics into production systems, and articulated robotic hands with sensors

North Carolina State University (Second of five years of NSF funding)

Speech processing data communications over power lines; image processing; VLSI algorithms and architectures; computing/communications network architecture

Rutgers University (Second of five years of NSF funding)

Glass formation from multicomponent alkoxide solutions; hydroxylated surface in sol-gel glasses and their use in ultrafiltration; sol-gel derived sealing materials for microelectronic packaging; thin film coatings using sol-gel processes; corrosion of refractories by alternate fuel impurities; toughening of ceramics; strengthening of composite materials; atomic diffusion on glass surfaces.

George Institute of Technology (Second of five years of NSF funding)

Material handling in manufacturing systems, warehouse systems, logistic systems, and automation and sensing

Pennsylvania State University (First of five years of NSF funding)

Basic and applied research specifically relevant to a wide range of ceramic dielectric materials used by industry concentrating on dielectrics for multi-layer ceramic capacitors

Texas A&M University (First of five years of NSF funding)

Facilitate carrying out of multidisciplinary research in all aspects of hydrogen technology, especially for the chemical industry

Worcester Polytechnic Institute (Final year of NSF funding)

> Management of technological innovations in the areas of computer-aided manufacturing, decision support systems, and office automation

Planning Grants

New Jersey Institute of Technology - Toxic Waste
University of Washington - Analytical Chemistry
Case-Western Reserve - VLSI System Integration
Arizona State University - Clean Room
Colorado School of Mines - Steel
Northwestern University - Tribology
Arizona State University - Electro-optics
North Carolina State University/Duke-Monoclonal Antibodies

Question: For the record, could you please provide a list of all of the NSF funded centers containing the amount of NSF and the amount of industry/university funding during each year for which the center has been in operation? Please indicate the specific focus of each of these centers.

Funding of Industry/University Cooperative
Research Centers
(In Thousands of Dollars)

	FY 1979		FY 1980		FY 1981	
Univer.	IND	NSF	IND	NSF	IND	NSF
MIT	550	0	600	0	750	0
RPI	120	270	240	300	540	210
U/Mass.	-	-	260	253	375	247
Ohio State	-	-	240	265	410	280
Case Western	-	-	-	-	210	210
Planning Grants		155		432		553
TOTAL	$ 670	$ 425	$1340	$1250	$ 2285	$1500

Senator Garn—Continued

	FY 1982		FY 1983		Estimate FY 1984	
	IND	NSF	IND	NSF	IND	NSF
MIT	800	0	880	0	950	0
RPI	560	160	660	100	750	0
U/Mass.	450	260	510	154	600	120
Ohio State	500	240	560	160	350	120
Case Western	295	210	345	160	480	110
Rhode Island	825	220	850	220	900	170
NCSU	450	175	500	175	600	150
Rutgers	300	175	360	175	420	160
Iowa	-	-	300	18	0	0
Georgia Tech	-	-	700	200	900	200
WPI	-	-	140	60	250	0
Texas A&M	-	-	160	150	400	200
Penn State	-	-	260	150	400	250
New Centers	-	-	-	-	3,000	1,000
Planning Grants	-	230		278		520
TOTAL	$4180	$1670	$6225	$2000	$10000*	$3000

* In addition, a total of $10M in state funds is also committed to augmenting the funding of a number of centers.

NATIONAL USER FACILITIES

In FY 85 you are requesting a $5.8 million or 12.6% increase in the amount of support for national user facilities. This would bring the total for such facilities to $52 million in FY 85.

Page MPS-10 of your budget justification lists a number of these facilities.

Question: Could you please provide for each of these facilities the original cost estimates for the construction of these projects and your current estimates for their completion.

Also please provide a list of the original expected completion dates for each of these construction projects and the actual current estimated completion dates.

Answer:

No construction is associated with the following national user facilities.

- Mathematical Sciences Research Institute
- Institute for Mathematics and its applications
- Institute for Advanced Study
- Mathematics Research Center
- Courant Institute of Mathematical Sciences
- Institute for Theoretical Physics
- Center for High-Resolution Electron Miroscopy
- Cornell University High Energy Synchrotron Sources

Original cost estimates and completion dates for construction projects and current cost estimates and dates for completion are:

	Original Cost Est./ Comp. Date	Current Cost Est./ Comp. Date
- Cornell Electron Storage Ring (CESR)	$ 39.5M/1987	$ 39.5M/1987
- Indiana University Cyclotron Facility (IUCF)	6.0M/1986	6.1M/1986
- Michigan State University (MSU) Phase II	33.0M/1985	33.0M/1986
- Synchrotron Radiation	2.9M/1980	3.5M/1981

Constant level-of-effort operation is planned for the National Magnet Laboratory and the Small Angle Scattering Facility.

MATERIALS RESEARCH LABORATORIES

During FY 85 you intend to increase the funding for your Materials Research Laboratories by $3.6 million, or 13.6%. You note in your justification that one new laboratory emphasizing basic engineering research in materials, may be established.

Question: What is your current plan relative to the establishment of this laboratory? Do you have a list of candidate locations for this laboratory? What funding profile would you propose for the support of this laboratory over the next 5 years?

Answer: The current plan is simply to make clear to the community that a proposal for a new materials research laboratory would be welcomed. There is no list of candidate locations. Our procedure is to inform the community and review proposals that are submitted. No specific funding profile is predetermined; it would depend on the proposals and review. In the past, few MRLs have been started at a level of approximately $0.5 million. The current MRL award funding on range is from $0.5 million to nearly $4.0 million.

SUPPORT OF RESEARCH FACILITIES, EQUIPMENT AND INSTRUMENTATION

In FY 83 the Foundation allocated $120.6 million for the support of research facilities, equipment and instrumentation. This amounted to 11.3% of the NSF research budget. In FY 84 you estimate that $197 million will be devoted to these activities. This represents 15.8% of the research budget. Your FY 85 proposal recommends an allocation of $237 million for these activities. This represents 16.7% of the budget.

Question: What percent of the overall R&D budget do you think should be allocated for this purpose -- obviously at some point this percentage has to level off, do you think that it has now reached that plateau.

Answer: The overall support allocated for research facilities, equipment, and instrumentation is dependent on several factors. These include the research opportunities available in a given field of science, the types of instrumentation needed to take advantage of these opportunities, and the costs of the specialized instrumentation involved. Since there are still many unmet instrumentation needs among NSF supported researchers, it is anticipated that the percent of total funds allocated for instrumentation will continue to rise in the foreseeable future to a level of approximately 20-30 percent of the total.

In your budget justification you state that "improvements in the instruments and facilities available to scientists and engineers frequently creates significant additional demands for increases in operating budgets."

Question: Could you please explain the implications of this increase in operating budgets on NSF's future budget requirements and the total number of grants that the Foundation will be able to support in the future?

Answer: It is essential that adequate support be provided for the maintenance and operation of equipment in order to take full advantage of the equipment as a tool for research. Provision of this support by NSF will generally result in larger grant sizes. Therefore, future budget increases would be used to maintain adequate support levels as well as increase the overall number of grants.

SUPPORT FOR SPECIAL EQUIPMENT
MATHEMATICAL AND PHYSICAL SCIENCES

Your budget justification indicates that support for special equipment in the Mathematical and Physical Sciences Directorate will increase by $3.9 million or 19.1% over the FY 84 level.

Question: Could you please describe the specific types of special equipment that are covered by this program and prepare a chart comparing the levels of funding for each of these equipment classifications during FY 83, FY 84 and FY 85.

Answer: Mathematics, Computer Research, Chemistry, and Materials Research provide specific support for research instrumentation and equipment intermediate in cost between and in addition to that normally included in research awards and that available at major university laboratories and national user facilities. This instrumentation is generally for group or departmental use and represents a very effective way of sharing experimental capabilities. Computer Research, Chemistry, and Materials Research have formal program elements for this purpose, while Mathematics provides such instrumentation through the Special Projects program element.

The types of equipment acquired under these program vary according to discipline. Examples for mathematics and computer research are mini-computers, array processors, and graphics displays. Typical items in chemistry are nuclear magnetic resonance spectrometers, mass spectrographs, and mini-computers, while examples in materials resarch include electron microscopes, laser systems, and surface analysis equipment.

Support for Special Equipment FY 1983-85
(Dollars in Millions)

Mathematical Sciences	$ 0.70	$ 0.90	$ 1.40
Computer Research	1.23	1.40	1.65
Chemistry	7.84	11.63	13.50
Materials Research	3.99	6.47	7.78
TOTAL	$ 13.76	$ 20.40	$ 24.33

GLOBAL ATMOSPHERIC RESEARCH PROGRAM

In FY 84 you requested $4.8 million for your Global Atmospheric Research Program. For FY 85 you are requesting $4.5 million or a decrease of $300,000. Your budget justification indicates that you intend to "phase down" the support for this program.

Question: Can you please describe your plans for this entire program and whether it will be completely eliminated or merge with other programs in the future?

Answer: The Global Atmospheric Research Program (GARP) is being phased down and will be phased out by no later than the end of FY 1989. This schedule provides scientists with a 10-year research phase following the major 1979 field programs of GARP. The complex scientific objectives of GARP and the richness and diversity of available GARP data require a research phase of at least this duration. Funding for GARP will continue to decrease through FY 1989 at a rate determined by the completion schedules of ongoing GARP research projects. After FY 1985, new projects proposed that use GARP data will be supported by either the Meteorology or Climate Dynamics Programs, as appropriate, in order to make the transition and phase-out for both ATM and for PI.I's out as smooth as possible. In order to carry out this plan GARP funds will be shifted into these two programs.

MATERIALS RESEARCH AND NATIONAL FACILITIES

Your budget justification notes that many problems in materials research require the use of large-scale facilities or assemblies of highly sophisticated instruments that can best be provided through "National Facilities".

Question: Could you please provide for the record a list of all of these facilities indicating their location, affiliation, and the level of NSF funding during FY 83 through FY 85.

Senator Garn—Continued

Materials Research and National Facilities
(Dollars in Millions)

Facility	Location/ Affiliation	FY 1983 Actual	FY 1984 Current Plan	FY 1985 Requested
Synchrotron Center (SRC)	Univ. Wisconsin/ Madison	1.66	2.30	3.70
Cornell High Energy Synchrotron Source (CHESS)	Cornell Univ.	0.67	0.72	0.90
National Magnet Laboratory (NML)	Massachusetts Inst. of Technology	4.65	5.30	5.50
National Center for Small Angle Scattering Research (NCASAR)	Oak Ridge National Laboratory	0.55	0.58	0.65
Center for High Resolution Electron Microscopy (CHREM)	Arizona State Univ.	(0.25)	0.75	0.65
Center for Research in Surface Science (CRISS)	Montana State Univ.	(0.23)	0.45	0.43
Center for Surface Analysis (CSA)	Univ. Minnesota	(0.23)	0.20	0.12
National Resource and Research Facility for Submicron Structures (NRRFSS)	Cornell Univ.	(0.16)	0.16	0.16
Total		7.53	10.46	12.11

( ) - transferred to NSF in FY 1984

Senator Garn—Continued

COORDINATED EXPERIMENTAL RESEARCH FACILITIES

Question: Could you please explain the organization and rationale for the Foundation's Coordinated Experimental Research Facilities grants?

Answer: In 1979 the Feldman Report pointed to a "crisis" in academic computer research. Ph.D. production was leveling against a rapid increase in demand while faculty and potential graduate students were leaving academic institutions for industry in increasing numbers. Academic research, outside of three or four departments, was strongly biased toward theoretical research. In response, NSF developed the Coordinated Experimental Research Program (CER) with the intention of expanding the base and improving the environment for experimental research by helping provide equipment, maintenance and technical assistance, by supporting large-scale, multi-investigator projects, and by developing CSNET, a computer network to serve the entire national computer research community in industry, government, and academia. Grants are five-year awards to provide sufficient continuity of support that competent staff can be attracted and significant facilities developed.

Unsurprisingly, the Foundation's Computer Research Equipment Program had prepared the way for the CER Program. For example, at the University of Washington and at Cornell University, both known as strong theoretical departments, the equipment grants stimulated ideas for experimental research leading to major activities in distributed operating systems and programming processes currently funded under the CER Program. As another example, a few young researchers at the University of Wisconsin obtained a grant for a small research testbed which they used to prove their initial ideas and develop the Crystal Project, a major experimental activity supported by the CER Program, the Department of Defense, Digital Equipment Corporation, and IBM Corporation.

If successful, the CER program will result in increasing experimental research activity throughout the Nation's academic institutions and will contribute materially to the training of future computer scientists and engineers. Early indications from the CER grantees, the CER oversight committee, and others in the community show a dramatic increase in graduate student enrollment, faculty recruitment, and grant and contract activity.

This year you are requesting an increase in support for that activity of $3.4 million or 26.2%. This will bring the new total to $16.4 million. Your budget justification indicates that you intend to add 4 to 5 new facilities bringing the estimated total to 22-24.

Question: What specific facilities, or types of facilities do you have in mind? What criteria will be used to select these facilities?

Answer: NSF has supported special- and general-purpose equipment, technical support staff, equipment maintenance, and other costs; graduate student and faculty support have been included where research and advanced development is required in the construction of the facilities.

Selection is based on NSF standard criteria for quality of the research to be performed. Some examples are:

- The computer scientists at Cornell University are pursuing research on the programming process. Through various projects they are developing support environments for programming, programming methodologies, functional programming languages, and program verification systems. The goal is to improve the programming process by making the production of reliable and effective software more disciplined, orderly, and efficient.

- There is great interest among researchers in the physical sciences and engineering in finding cost-effective resources for large-scale numerical computation. The researchers at Yale University's Department of Computer Science are investigating new algorithms and architectures for scientific programming. They are particularly interested in attached specialized processor architectures and in the application of code compaction and optimization techniques to algorithms transformed from sequential processors to highly parallel processors.

- The University of Utah has a long history of leadership in graphics research. A significant fraction of all U.S. researchers in computer graphics have been associated with the University either as students, faculty, or staff researchers. The University is committed to building a major center for computer-aided design and manufacturing. The CER activity serves to support the core of basic research into the underlying principles of such systems while other sources of support, local, governmental, and industrial, will provide the real CAD/CAM environment in which the computer scientists will perform their research.

- Duke University and the University of North Carolina at Chapel Hill are developing a joint center of Very Large Scale Integration (VLSI) research. They work closely with the newly formed Microelectronics Center of North Carolina and with local industry to examine VLSI research issues from the device physics level through the fabrication of new special and general purpose architectures. The two campuses concentrate their research on CAD/CAM systems for VLSI design and on VLSI-based architectures. The closely related and complementary activities in computer graphics at the University of North Carolina also has been enhanced.

Question: How many facilities in total does NSF expect to participate in the Coordinated Experimental Research program and when would this level be reached?

Answer: NSF has planned to add 4-5 sites per year, reaching a steady-state of 20-25 funded by FY 1985. This will not satisfy the national need for support of the infrastructure of academic computer research. As a result, the Foundation expects to continue the CER program and remain open to new proposals of this type.

ENGINEERING AREAS OF NATIONAL IMPORTANCE

Question: Last year I asked you to provide a listing of those engineering research programs, regardless of discipline, that were considered to be of major national significance. Please update this listing.

Answer: In addition to those areas listed last year, other areas are increasing in national significance. Among these are:

Electrical, Computer, and Systems Engineering

- Machine Design and Control
- Biological/Molecular Computing Devices

Chemical and Process Engineering

- Photocatalysis and Electrochemical Processes
- Intelligent Manufacturing Processes
- Microcontamination Control
- Novel, High-Purity Separations
- Biochemical and Microbial Technology
- Strategic Minerals Extraction and Metallurgical Processing

Civil and Environmental Engineering

- Environmental Engineering
- Coastal and Ocean Engineering

Mechanical Engineering and Applied Mechanics

- High Temperature Mechanical Behavior of Metals and Ceramics
- Tribology
- Computer Integrated Manufacturing Systems
- Multiphase Heat Transfer
- Transition from Laminar to Turbulent flows

INSTRUMENTATION ACTIVITIES

During your FY 83 hearing, I also asked the Foundation whether it would be necessary to develop a program requiring matching grants from industry in order to truly address the instrumentation needs at universities. In response, the Foundation stated, "many analysts and observers agree that the university research instrumentation problem will be solved only with strong private sector participation".

Last year I asked what goal and objectives you have established concerning industrial/local match for instrumentation. At that time you indicated that a 50% match was required for "special equipment" in engineering and chemistry.

Question: Is this policy still in effect and what equipment has been funded through this mechanism?

Answer: For the Engineering Equipment Grants program, the institutional contribution is expected to be 50 percent of the total cost of the equipment. In the Chemistry Equipment program, for FY 1984, the Foundation supports two-thirds of the equipment cost, while the institution provides one-third of the cost. The reduced matching requirement in Chemistry is being tried on an experimental basis in order to ascertain what should be the matching requirements in future years.

Question: What other guidelines have been established?

Answer: No other guidelines have been established beyond those already existing in Engineering and Chemistry. New guidelines will be considered based on the results of the matching experiment now underway in Chemistry.

INSTRUMENTATION

As you will recall, the FY 82 Senate Appropriations Committee Report contains specific language relative to the Instrumentation problem and I quote, " The Committee recognizes the need for an instrumentation replacement program on a national scale. Information presented to the Committee to date, however, indicates that the Foundation has not adequately identified the roles of other government agencies and the private sector in addressing the instrumentation needs of universities. Additionally, the Committee is concerned about the priority process that will eventually be used for the selection of grantees." The Committee directed the Foundation to "continue developing a plan for an instrumentation program using such funds as may be necessary."

Last year I asked you for a status report on this plan and how you intended to address the Committee's concern about the role of other Federal agencies?

Question: What progress have you made since last year's hearings?

Answer: Only the Department of Defense, the National Institutes of Health, and the Department of Energy have established separately budgeted university research instrumentation activities. In FY 1984, these efforts will total an estimated $30.0 million in the DOD; $19.8 million in the NIH; and $4.0 million in the DOE. Only the Department of Energy plans an increase in FY 1985, to $6.0 million. Support in the other three agencies is planned to remain level with FY 1984.

The Foundation is continuing to work with these and other Federal agencies to encourage strengthened support for university research equipment. In addition, it will be providing an estimated total of $237.0 million for research instrumentation and facilities across its many programs, an increase of 20.3 percent over the FY 1984 level.

Senator Garn—Continued

Status of University Research Instrumentation Initiative Funding by Major Department and Agency (Dollars in Millions)

	FY 1983	FY 1984	FY 1985	
DOD:				
Army	$10.0	$ 10.0	$10.0	
Navy	10.0	10.0	10.0	
Air Force	10.0	10.0	10.0	
Subtotal	30.0	30.0	30.0	
D. of Energy	-0-	4.0	6.0	
NIH	12.0	19.8	19.8	
NSF	-0-	70.6	36.5	See explanation below
NASA	-0-	-0-	-0-	See explanation below
Interior	-0-	-0-	-0-	
Agriculture	-0-	-0-	-0-	
EPA	-0-	-0-	-0-	
Total	$42.0	$124.4	$92.3	

Only Three Agencies Have Initiated Univ. Instrumentation Initiative

Only DOD, NIH, and the Department of Energy have established separately identified university research instrumentation initiatives in the spirit of the NSF effort led by Dr. Langenberg.

NSF funding for FY 1984 and FY 1985 in the above table is the increase in the budget for "major" and for "other equipment" in the science disciplines and engineering.

NSF never established a separately identified major university instrumentation initiative. Such a program was proposed but OMB rejected it. Instead, NSF provided significant increases for instrumentation in the disciplines and engineering.

Regarding NASA, OMB rejected a NASA request for $10 million for a university research instrumentation initiative in FY 1985. The other agencies shown in the table have not started such an effort and there is no indication that they plan to do so.

No Quick Way to Get Data on Total Federal Funding for Univ. Research Instrumentation

Agency accounting records do not track university research instrumentation. Most department and agency accounting records do not reveal how much funding goes to universities. Even though Federal Funds for Research and Development shows amounts going to universities, this data is obtained through inputs from agency people who go to a lot of special work to get the data. They do not develop detailed data on instrumentation.

Definitions are also a problem. What should be counted? Should NSF, for example, include major equipment? Funding for major equipment is included in the NSF line in the above table. But what does this mean for other agencies? The distinction between capital equipment and instrumentation is fuzzy at best and then there are those major instruments that evolve into facilities.

We can probably get an estimate, but it will take 3 to 6 months to do so. There will have to be agreed upon ground rules as to what is and what is not to be included in advance, if we are going to avoid serious trouble. So far, in this area, the only thing that there is a lot of is fuzz. University officials state that 25% of all equipment is obsolete --But what is 25% of all? We need better data. No one should question that. But we should not expect enthusiastic cooperation from the other agencies in going after this one.

Once again, I would like to ask you if the Foundation has determined what types of equipment, such as mini-computers, could be more appropriately supplied by industry or universities, and what kind of equipment would not likely be available to researchers without Federal investment?

Question: What studies have you conducted that would guide you in making these resource allocation decisions?

Answer: A partial understanding of factors influencing private-sector donations of research equipment to universities has been gained through operation of the minicomputer gifts and donations program over the past three years and through an early study of the impact of the Economic Recovery Tax Act of 1981.

NSF's experience has shown that several major manufacturers are willing to make significant price concessions to NSF awardees. It has become clear that manufacturers place major importance on the quality of research to be done. Recognizing that they themselves do not have the expertise to evaluate proposed research projects, they rely on the Foundation's peer review process to identify highly meritorious work. They feel that this allows them to maximize the scientific benefits of their equipment, thus encouraging them to offer discounts or donations.

What determines what each company feels it can offer in the way of discounts/donations is inferential, since much of the information is proprietary. Some important factors seem to be the desire to expose graduate students to a particular manufacturer, to have the equipment cited in the research literature, to build up market-share and, often to make long-term contributions to basic scientific and engineering research.

The Foundation has conducted an early assessment of the effect of the Economic Recovery Tax Act of 1981. Findings suggest that the improved tax treatment contained in the legislation will result in increased research equipment donations to universities. Other factors appearing to influence the donation decisions are suitability of equipment, responding to an increased number of university requests, helping universities produce the knowledge and manpower needed to keep the Nation internationally competitive, and market development. The results of the formal assessment confirm the programmatic observations of willingness of the private sector to assist in providing universities with research instrumentation.

COMPARISON OF PLANNED EQUIPMENT PURCHASES

Last year I asked you to include a table in the record comparing your planned equipment purchases for FY 1982, FY 1983 and FY 1984.

Question: Could you please update this table to include the FY 1985 figures?

Answer:

Planned Equipment Purchases

Object	Actual FY 1983	Budget Request FY 1984	Current Plan FY 1984	Estimate FY 1985	Difference FY 1985/84
Equipment:					
Administrative Services Equipment	$ 290,880	$300,000	$112,400	$ 359,000	$ 246,600
Data Processing Equipment	866,831	625,000	600,000	1,650,000	1,050,000
Total Equipment	1,157,711	925,000	712,000	2,009,000	1,296,000

PLANNING AND EVALUATION

In the past this Committee has been quite concerned with increasing NSF's capability to conduct long range planning and to develop policy positions relative to national and international science issues. I noticed in your budget justification that at the beginning of FY 84 you had a carryover of $14,631,790 from prior years. Of this amount $367,000 was originally planned to be used for your Planning and Evaluation program.

Question: Why were you unable to obligate this money in FY 83?

Answer: The $367,000 unobligated balance resulted from the inability to obligate funds for two projects prior to the September 30 end of FY 1983.

Question: What specific activities that had been planned for 83, were not completed as a result of this unobligated balance?

Answer: The first of these projects was a series of workshops to review papers on emerging scientific issues. Several of the workshops were held in FY 1983, but because of scheduling and making contractual arrangements for attending participants, it was not possible to obligate funds for the balance of the workshops prior to the end of the fiscal year. The unobligated balance of $84,000 has been made available for the same purpose in FY 1984.

The second project was a two-phase study relating to supercomputer networking. It was possible because of the relatively small cost of the first phase, to award the contract on a sole-source basis. However, the second phase, estimated at $280,000, required competitive bidding under federal procurement regulations. It was not possible to issue a Request for Proposal, receive and review proposals, and select a contractor prior to September 30. How to proceed with a follow-on study in FY 1984 is currently being discussed with the Advisory Committee for Advanced Scientific Computing Resources.

Your budget justification states that funds for Foundation-wide activities in planning and evaluation will be provided as needed from the discipline-oriented research activities. You estimate that up to a total of $2 million might be provided for such purposes.

Question: How does this estimate relate to prior amounts that have been available for such purposes?

Answer: The $2.0 million requested is consistent with amounts obligated over the past several years. Obligations for Planning and Evaluation by fiscal year were:

FY 1983	$ 1,881,360
FY 1982	1,317,967
FY 1981	1,841,303

Question: What specific activities in the area of planning and evaluation do you intend to undertake during FY 85?

Answer: Individual projects funded in FY 1985 will depend on priorities as identified by NSF management with inputs from advisory committees, such as the Advanced Scientific Computing Resources Advisory Committee. Topic areas in FY 1985 will depend on national scientific and engineering needs, opportunities and problems, which are identified.

Question: Could you please prepare for this Committee, By October 1, 1984, a plan for the use of these funds during Fiscal Year 1985.

Answer: A plan for the use of FY 1985 Planning and Evaluation funds will be prepared and submitted to the Committee by October 1, 1984.

ASSUMPTION OF RESPONSIBILITY

Question: Please prepare for the record, a list of all activities expected to be transferred to NSF during FY 85 and the cost associated with assuming the responsibility for these activities.

Answer: No activities are expected to be transferred to NSF during FY 1985.

Question: Also prepare a list of those activities and the associated FY 85 cost that will be transferred out of NSF.

Answer: No activities will be transferred out of NSF in FY 1985.

SECURITY CONSIDERATIONS IN R&D

Question: Could you please comment on NSF's current position relative to the classification of scientific research results?

Answer: Hardly any NSF-funded research is classifiable, so few problems exist for the Foundation in this regard. The NSF-National Security Agency informal agreement on cryptology research is working successfully.

The Foundation continues to support the openness of scientific communication to the maximum extent possible, consistent with national security needs of the nation. The Foundation supports the findings and recommendations of the 1982 report of NAS panel on "Scientific Communication and National Security" (the Corson Report), which NSF funded in part.

NSF has been a member of a working group to make recommendations to the National Security Council on treatment of unclassified, but national security sensitive, information.

RELATIONSHIP OF BUDGET JUSTIFICATION TO CONGRESSIONAL OPERATING PLAN

Pages NSF-34 through NSF-43 of your budget justification contain a detailed breakdown of your current FY 84 budget plan. A comparison of that plan with the operation plan submitted to the Appropriations Committees on November 9, 1983 reveal numerous small discrepencies, some of which increase the amounts available to programs and others decrease the amounts. In addition several larger changes are also contained in that table. For example the funds available under the Physics subactivity in your table total $105,900,000 whereas the congressional operating plan shows $106,260,000 for that subactivity.

Question: Could you please provide a brief explanation of the various small deviations (those less than $250,000) and a more detailed explanation of those exceeding $250,000.

Answer: The primary change to the Foundation's FY 1984 Operating Plan between November, 1983 and January, 1984, is attributable to the government-wide pay increase, and associated changed in calculation of some benefits, of January, 1984. The estimated 9-month cost of this pay increase for FY 1984 is $1,310,000.

The NSF Supplemental Appropriation Request proposes that half of this sum, $655,000, be absorbed, on a prorated basis, from the Research Activities:

Mathematical & Physical Sciences	$ 227,000
Engineering	77,000
Biological, Behavioral and Social Sciences	142,000
Astronomical, Atmospheric, Earth and Ocean Sciences	209,000
TOTAL	$ 655,000

In the FY 1984 Current Plan (January), this amount was reprogrammed to the Program Development and Management Activity. The Supplemental Request also asked for the appropriation of an additional $655,000, which is shown in the January Current Plan, and requested that the PD&M limitation be raised by $1,310,000 to a total of $66,592,350.

The changes in the Current Plan for subactivities within the research activities primarily reflect this reprogramming action. In addition, as explained in the letter of January 20, 1984, to the Chairman of the Subcommittee, (see attached) within the MPS Activity, additional funds totaling $700,000 were made available to the Chemistry subactivity from the other subactivities in MPS to accommodate the funding impact of the support of instrumentation in Two- and Four-Year Colleges by Chemistry. The net effects of this adjustment within MPS plus the reprogramming to PD&M account for the changes alluded to in the question.

Finally, the January Current Plan contains an additional $356,000 in the U.S. Antarctic Program, the estimated 9-month costs of the military pay increase. At the same time, as our January 20 letter indicated, we were reprogramming $244,000 from the Operations Support Progam in USAP into the Research Program. These funds will provide support for scientists on the Melville, a ship in the academic fleet, and the icebreaker Westwind during research cruises in the Antarctic Peninsula area during the 1983-84 season.

REIMBURSEMENT OF DOD RETIREMENT COSTS

This year, for the first time, you are requesting $6 million to reimburse the Department of Defense for military retirement cost associated with the Antarctic Program.

Question: I understand that this is a government-wide requirement -- is that correct?

Answer: Public Law 98-94 - September 24, 1983, established on the books of the Treasury a fund to be known as the Department of Defense Military Retirement Fund to be administered by the Secretary of the Treasury. The Fund is to be used for the accumulation of funds in order to finance on an actuarially sound basis liabilities of the Department of Defense under military retirement programs.

For FY 1984 and prior years there was a single Department of Defense appropriation to cover current year retirement pay costs. For FY 1985 the military pay appropriation of each of the armed services includes a line item "accrued retirement benefits." Agencies using military personnel on a reimbursable basis will fund their accrued military retirement costs.

Question: How did the Foundation determine that the cost would be $6 million?

Answer: The amount was determined by OMB based on application of the DOD accrual rate, 51 percent of basic pay amounts.

Question: For the record, please provide a detailed accounting of these costs including the number of personnel involved. Also provide the amount that would have been necessary for DOD reimbursement if today's personnel costs were applied to your FY 83 and FY 84 DOD personnel levels.

Answer: The amount was determined by OMB; therefore, NSF does not have the details. In February 1984, there were 806 military personnel assigned to the program.

Approximately the same number of military personnel were involved in FY 1983 and FY 1984. If the rate had been the same as that used for FY 1985, the cost would have been the same less adjustments for military pay raises in FY 1983 and FY 1984. Since the amount of basic pay that is involved in pay raises is not known to NSF, we cannot provide exact figures. (Military pay raises usually affect allowances, such as housing and subsistence, in addition to basic pay.)

Question: Does this government-wide policy require the DOD to reimburse non-defense agencies for the retirement cost of civilians detailed to DOD?

Answer: Civilian retirement costs are not addressed in Public Law 98-94.

DISTRIBUTION OF BUDGET CUTS

Question: Please prepare for the record a table showing how the Foundation would distribute a $10 million, $20 million, $30 million, $40 million, and $50 million general budget reduction across its subactivities.

Also do the same for a $10 million, $20 million, $30 million, $40 million and $50 million general increase.

Answer: As background for the answer to this question a brief summary of the requested increases for FY 1985 is presented below.

o Adjustment necessary to maintain current service levels.		$59 million
o Planned growth in PYI program to permit 200 new awards and adjustment for military pay in the USAP.		$18 million
o Special Initiatives		$41 million
- Supercomputing	(14)	
- Engineering Centers	(10)	
- AVC	(5)	
- VLBA	(12)	
o Enhancements in selected research areas		$34 million
- MPS	(13)	
- ENG	(3)	
- BBS	(14)	
- AAEO	(4)	
o Instrumentation Increases		$28 million

If reductions from the requested level should be necessary, the Foundation would make them as follows.

$10 million reduction

- Precollege Science and Engineering Education would be reduced by $10 million, recognizing that the likely carry over in this activity from FY 1984 to FY 1985 (i.e. about $30 million) will more than compensate for this reduction.

$20 million reduction

- Additional $5 million reduction in Precollege Science and Engineering Education, recognizing that the likely carry forward in FY 1985 will more than compensate for this reduction.
- Reduction of instrumentation increases by $5 million.

$30 million reduction

- o Additional $5 million reduction of instrumentation increases.
- o Proportional reduction of $5 million in enhancements and/or ongoing programs in MPS, ENG, BBS and AAEO.

$40 million reduction

- o Additional $3 million reduction of instrumentation increases.
- o Proportional reduction of $7 million in enhancements and/or ongoing programs in MPS, ENG, BBS and AAEO.

$50 million reduction

- o Additional $3 million reduction of instrumentation increases.
- o Proportional reduction of $7 million in enhancements and/or ongoing programs in MPS, ENG, BBS and AAEO.

The requested table showing how the Foundation would distribute these reductions by directorate is given below.

FY 1985 FUNDING DISTRIBUTIONS AT DIFFERENT NSF TOTALS
(Dollars in millions)

ACTIVITY	FY 1985 -$10.0	FY 1985 -$20.0	FY 1985 -$30.0	FY 1985 -$40.0	FY 1985 -$50.0
MPS	$416.7	$414.4	$410.3	$406.5	$402.6
ENG	147.1	146.5	145.4	144.2	143.0
BBS	253.1	252.4	250.7	248.8	246.9
AAEO	373.5	372.1	369.1	366.1	363.1
STIA	46.9	46.8	46.8	46.8	46.8
PD&M	70.9	70.9	70.9	70.9	70.9
SUBTOTAL	$1,308.2	$1,303.2	$1,293.2	$1,283.2	$1,273.3
USAP	$115.1	$115.1	$115.1	$115.1	$115.1
SEE	$65.7	$60.7	$60.7	$60.7	$60.7
SFC	$2.8	$2.8	$2.8	$2.8	$2.8
TOTAL	$1,491.8	$1,481.8	$1,471.8	$1,461.8	$1,451.8

If general increases in the FY 1985 request are considered, the Foundation would proceed as follows:

$10 million increase

- o This amount would be added to the supercomputing initiative permitting the addition of one additional supercomputer center in FY 1985.

$20 million increase

- The supercomputer initiative would be increased by $2 million to provide support for needed local hardware, improvements in software productivity, and to provide access to new prototype supercomputers.

- Selected enhancements ($8 million)
  - MPS: An additional $2 million would be used to accelerate work on dectector and luminosity upgrades at CESR and to expand the Chemistry of Life processes emphasis.
  - BBS: Research in plant science would be increased by $2 million.
  - ENG: Funding for the Engineering research centers would be increased by $2 million.
  - AAEO: Funding for the ocean sciences would be increased by $2 million for global ocean/climate studies.

$30 million increase

- An additional $10 million would be added to the supercomputing initiative permitting the addition of one more supercomputer center in FY 1985.

$40 million increase

- Funding for instrumentation and instrumentation operation increased in each of the research directorates.

$50 million increase

- Selected Enhancements
  - MPS: An additional $4 million to expand research on the chemistry of materials.
  - BBS: Support for Social, Behavioral and Economic Sciences increased by $2 million.
  - ENG: Additional $4 million for thrust areas such as computer integrated manufacturing systems, plasma-chemical engineering and optical computing components.
  - AAEO: Additional $2 million for global ocean/climate studies.

Senator Garn—Continued

The requested table showing how the Foundation would distribute these increases by directorate is given below.

FY 1985 FUNDING DISTRIBUTIONS AT DIFFERENT NSF TOTALS
(Dollars in millions)

ACTIVITY	FY 1985 +$10.0	FY 1985 +$20.0	FY 1985 +$30.0	FY 1985 +$40.0	FY 1985 +$50.0
MPS	$421.9	$424.9	$431.1	$435.7	$439.7
ENG	149.6	152.1	155.1	156.2	158.2
BBS	254.3	256.5	257.9	259.3	261.3
AAEO	374.7	376.9	376.3	379.1	381.1
STIA	46.9	46.9	46.9	47.0	47.0
PD&M	70.9	70.9	70.9	70.9	70.9
SUBTOTAL	$1,318.2	$1,328.2	$1,338.2	$1,348.2	$1,358.2
USAP	$115.1	$115.1	$115.1	$115.1	$115.1
SEE	$75.7	$75.7	$75.7	$75.7	$75.7
SFC	$2.8	$2.8	$2.8	$2.8	$2.8
TOTAL	$1,511.8	$1,521.8	$1,531.8	$1,541.8	$1,551.8

NOTE: Totals may not add due to rounding.

OTHER SOURCES OF SUPPORT

Question: Please prepare a chart for the record showing the estimated level of support in each of the science and engineering activities of the Foundation from the private sector and from other government sources. Please use the most recent data available.

Answer: The FY 1984 estimates by discipline for NSF and other Federal sources are included in the table that follows. These estimates were obtained from "Federal Funds for Research and Development, Volume XXXII."

Support from the private sector for R&D activities at academic institutions totaled $326 million in FY 1982. There is presently no data available that give private sector support to academic institutions by discipline.

NSF AS PERCENT OF TOTAL FEDERAL RESEARCH SUPPORT, BY DISCIPLINE FY 1984

(Dollars in Thousands)

Field of Science	Total, All Agencies	NSF	NSF Percent of Total
Physical Sciences:			
Astronomy............	338,320	83,970	24.8%
Chemistry............	528,990	108,710	20.6%
Physics..............	2,078,307	160,388	7.7%
Physical Sciences,NEC	233,220	438	.2%
Subtotal, Phys. Sci	3,178,837	353,506	11.1%
Math & Computer Science			
Mathematics..........	161,306	45,546	28.2%
Computer Sciences....	249,508	40,218	16.1%
Math & Comp. Sci, NEC	70,777	46	.1%
Subtotal, Math,Comp	481,591	85,810	17.8%
Environmental Sciences:			
Atmospheric Sciences.	455,615	109,101	23.9%
Geological Sciences..	373,995	98,749	26.4%
Oceanography.........	247,899	115,520	46.6%
Environmental, NEC...	111,126	11,069	10.0%
Subtotal. Environ..	1,188,635	334,439	28.1%
Engineering:			
Aeronautical.........	797,630	661	.1%
Astronautical........	357,488	245	.1%
Chemical.............	107,875	24,852	23.0%
Civil................	175,002	36,325	20.8%
Electrical...........	683,713	39,631	5.8%
Mechanical...........	202,729	20,969	10.3%
Metallurgy & Materials	359,655	33,347	9.3%
Engineering, NEC.....	802,806	11,597	1.4%
Subtotal, Engrg....	3,486,898	167,627	4.8%

NSF AS PERCENT OF TOTAL FEDERAL RESEARCH SUPPORT, BY DISCIPLINE
FY 1984

(Dollars in Thousands)

Field of Science	Total, All Agencies	NSF	NSF Percent of Total
Life Sciences:			
Bio. & Agricultural:			
Biol (Excl. Environ)	2,307,727	161,176	7.0%
Environmental Bio...	169,473	66,694	39.4%
Agricultural........	618,505	719	.1%
Subtotal, Bio & Agr	3,095,705	228,589	7.4%
Medical Science......	1,985,317		.0%
Life Sciences, NEC...	170,006	157	.1%
Subtotal, Life Sci.	5,251,028	228,746	4.4%
Psychology:			
Biological Aspects...	76,015	6,317	8.3%
Social Aspects.......	127,131	3,146	2.5%
Psychology, NEC......	68,568	250	.4%
Subtotal, Psych....	271,714	9,713	3.6%
Social Sciences:			
Anthropology.........	20,351	6,668	32.8%
Economics............	171,219	13,413	7.8%
Political Sciences...	6,721	3,178	47.3%
Sociology............	59,425	4,099	6.9%
Social Sciences, NEC.	174,564	12,101	6.9%
Subtotal, Soc. Sci	432,280	39,459	9.1%
Other Sciences, NEC	372,256	21,165	5.7%
TOTAL, ALL FIELDS	14,663,239	1,240,465	8.5%

TRAVEL COSTS

In FY 85 you are asking for an increase in travel of staff proposal reviewers, panelists and advisors of $480,000. This represents a 15.9 percent increase over the 84 level. Why is such a large increase required at this time?

Answer: The overall Foundation limitation on the amount available for travel has not been increased in two years. During the same period, as a result of increases in fares, the actual travel performed has decreased despite the requirements of on-going programs and the addition of new programs, particularly in Science and Engineering Education Activities. Of the additional $480,000, $100,000 is allocated for the panel and staff travel requirements of the Science and Engineering Education programs. The remaining increases are distributed as follows:

Additional staff and panel travel in Science and Engineering Education Activities	$100,000
Eight percent increase in the base amount for staff travel	136,000
Eight percent increase in the base amount for travel of panelists, etc.	85,000
Additional staff travel	159,000
TOTAL	$480,000

You expect that travel for proposal reviewers, panelists and advisors will increase by $155,000 or 13.7 percent while travel for NSF staff will increase by $325,000 or about 20 percent.

Question: Would you please explain the reason for the difference in the percentage increases?

Answer: The difference in the percentage increase for staff travel results from increased programmatic responsibilities for the staff in FY 1985.

PAY SUPPLEMENTAL

You indicate that your additional salary and direct benefits cost associated with the January 1984 payraise increase are estimated at $1,310,000. You further expect that one half or $655,000 of this will be absorbed from within the total FY 84 appropriations.

Question: From what areas do you expect to reprogram this $655,000?

Answer: The FY 1984 Current Plan contained in the FY 1985 estimates to Congress has been adjusted to absorb one-half to the total estimated cost of the January 1984 pay increase as follows:

Mathematical and Physical Sciences	$ -227,000
Engineering	-77,000
Biological, Behavioral and Social Sciences	-142,000
Astronomical, Atmospheric, Earth and Ocean Sciences	-209,000
Program Development and Management	+655,000
TOTAL	-0-

Question: What would be the effect if Congress did not provide the remaining $655,000 in a pay supplemental?

Answer: If the total requested $1,310,000 increased in the Program Development and Management limitation is approved by the Congress and the additional funding of $655,000 is not approved further reprogramming from the research activities to Program

Development and Management will be required to meet the necessary cost of the pay increase.

CONSULTANTS AND EXPERTS

Question: How much do you intend to spend for consultants and experts during FY 84 and FY 85?

Answer: The amounts budgeted for consultants and experts (including the National Science Board) are $600,000 in FY 1984 and $600,000 in FY 1985.

MANAGEMENT INFORMATION SYSTEM

Your FY 85 budget contains a request for $1,050,000 for data processing equipment.

Question: How much will obligated for workstations in FY 84?

Answer: In FY 1984, the plan is to obligate $600,000 for workstations and associated central facility and communications upgrades.

Question: How much will be obligated for software development and training in FY 84?

Answer: In FY 1984, $100,000 is planned for software development. Training of the NSF staff in use of the new computing environment will be conducted in-house by the Division of Information Systems and, consequently, does not require additional funds.

Question: How much for FY 85?

Answer: In FY 1985, $196,000 is planned for software development, and in-house training will continue.

Question: Is the amount for these later two aspects (software development and training) adequate?

Answer: The adequacy of software development funds will depend, in large part, on the demand for additional system capabilities. It is anticipated that an evolving requirement for a high level Decision Support System will place the greatest single demand on resources. The FY 1985 request is to provide sufficient funds for a moderate level of effort in support of new projects such as this.

In-house training can continue, provided there are no additional staffing cuts.

Question: Where do you stand on implementation of your long-range ADP plan:

Answer: The major FY 1984 milestone of the Long Range Plan -- the termination of the NSF Honeywell System at the end of this fiscal year -- is on schedule. Cuts in staffing and budget have delayed the implementation of the mission-oriented systems, such as the Financial Management, Proposal and Reviewer Systems, and have caused delays in acquiring workstations. However, if no further slippages in delivery schedules occur, it is expected that the transition from the Honeywell to the mini/micro environment will be accomplished by September 30, 1984.

QUESTIONS SUBMITTED BY SENATOR HUDDLESTON

ESTABLISHED INSTITUTIONS VERSUS OTHERS

I understand your peer review system, but I continue to have concerns about the number of grants awarded to large, established institutions at the expense of small ones.

Question: What was your experience in fiscal 1984 in broadening the number of institutions receiving grants?

Answer: We will not know until the end of the fiscal year how many different academic institutions received NSF awards in FY 1984. In FY 1983, the number was about 400 and will probably increase somewhat in FY 1984 due to the expansion of the Science and Engineering Education Activity and the initiation of new programs such as the Presidential Young Investigator Awards.

Question: Will you be making any further efforts in FY 85 to insure that grants are awarded on a more geographically dispersed basis and to a wide range of institutions?

Answer: The academic institutions receiving NSF research grants in FY 1983 ranged from small, four-year colleges to many of our major research universities. Research awards went to all 50 states, plus the District of Columbia in FY 1983. We fully expect that the range of institutions receiving awards will increase in FY 1984 and again in FY 1985 because of the growth in our Science and Engineering Education Activity as well as the increased emphasis we are placing on awards to predominantly undergraduate institutions.

Question: Is it a general rule that smaller grants (in dollar terms) are made to the small institutions and does this reflect less sophisticated or advanced research at these institutions?

Answer: If, by "smaller institutions" is meant "predominantly undergraduate institutions," then in FY 1983, the size of the awards going to such institutions was considerably below the average in fields like astronomy and physics. This probably reflects the fact that research in these fields generally involves very costly and sophisticated instrumentation such as accelerators and telescopes that are more likely to be found at major institutions with large research activities. In other fields like atmospheric sciences, electrical and computer engineering, and earth sciences the size of awards to investigators in predominantly undergraduate institutions was not significantly below average, and in some cases -- ocean sciences, information science, mechanical engineering, and chemical engineering --the awards were actually above average in size.

There is no general rule that associates the size of an institution with the size of an award. NSF attempts to support the best researchers at a level that will allow them to gain maximum research results, independent of their institutional affiliation.

Question: In which areas can a less well-known, less established institution compete as well as an MIT, Stanford, etc.?

Answer: A large number of institutions that are less well known than MIT or Stanford nevertheless have strong competitive departments in selected fields of science and engineering. The critical determinants are the quality of the faculty and graduate students, the faculty time available for research, the emphasis which a college or university places on research in its hiring and tenure decisions, and access to needed research facilities and instrumentation.

Equipment and facility requirements vary from field to field. Thus, it may be easier to become competitive in some disciplines than in others. However, even in instrumentation intensive disciplines such as astronomy or physics, there are national centers and user facilities supported by the NSF that are available, on a competitive basis, to investigators from any college or university.

There is no particular "area" in which less well known institutions are better able to compete than others. They are competitive in all areas. Success depends primarily on the decisions which a particular institution has made about its priorities and its willingness to commit resources to supporting a strong research environment.

Question: How does the dollar value of instrumentation grants vary between the 10 to 15 institutions receiving the largest amounts and other institutions receiving such funding?

Answer: Research instrumentation and associated facilities are supported in several different ways at the NSF. Most frequently, part of the budget for an individual research project will be for equipment, with the costs averaging around $20,000 - $30,000. Support in this mode is very common in fields like chemistry or the biological sciences and less common in engineering. These differences result from differences in research requirements among disciplines.

Some Foundation programs, e.g., chemistry, astronomy, materials research, and biology, do make instrumentation awards per se. In some instances, the instrumentation must be built, and in other instances, it can be bought 'off the shelf.' Frequently, it will be used by a number of investigators, whereas equipment purchased in conjunction with a specific project may be smaller and more dedicated to one or a few users. Multi-user equipment can be quite expensive -- ranging up to $150,000 or more in cost -- as can instrumentation which must be built.

Finally, programs such as physics, materials research, oceanography, and astronomy, support laboratories or national centers or "user facilities": The Electron Storage Ring (Physics) and the Submicron Research Facility (Engineering) at Cornell; the Superconducting Cyclotron (Physics) at Michigan State University; the Very Large Array (Astronomy) at Socorro, New Mexico; the Atlantis II and the Alvin at Woods Hole Oceanographic Institute (Ocean Sciences), or the National Magnet Laboratory (Materials Research) at MIT.

Total NSF support for instrumentation and research facilities in FY 1983 at the top 15 institutions was approximately $30.0 million. Most of these institutions were receiving support for instrumentation in multiple ways -- individual research projects; multi-user instrumentation grants; laboratories; national centers or user facilities. Institutions with relatively limited instrumentation support -- $100,000 or less -- received it primarily through project grants and an occasional instrumentation award for multiuser equipment.

SCIENCE EDUCATION

I would assume that you are as interested in improving science and engineering education in Kentucky -- and Utah -- and similar less populous states -- as you are in improving it in the Harvard -- MIT area, for example. Yet, the needs and approaches in the two areas obviously vary.

Question: How are you seeking to insure that appropriate actions are taken in states like Kentucky?

Answer: The Foundation's program for supporting activities to strengthen precollege science and mathematics was announced to the public on December 7, 1983, in the Federal Register. We have also sent a program announcement to all institutions of higher education and other interested groups in each state. Strong efforts have been made to alert all interested parties that the National Science Foundation is supporting efforts to improve precollege science and mathematics.

Several proposals have been submitted by institutions in Kentucky and are currently being evaluated by a group of scientists and educators from around the nation. The outcome of this peer review process forms the preliminary basis upon which funding decisions are made.

INDUSTRIAL SCIENCE AND TECHNOLOGY INNOVATION

In FY 85 you are requesting an increase of $5.8 million in your Industrial Science and Technology Innovation program in order to comply with the percentages required under the Small Business Innovation Development Act of 1982.

Question: As a result of that increase how many Phase I and Phase II awards will be made during FY 85 and how does this compare to the FY 83 and FY 84 levels?

Answer:

Senator Huddleston—Continued

Number of Awards and Average Award Amount

	FY 1983		Est. FY 1984		Est. FY 1985	
Phase I (six months)	(4)	30K	(100)	35K	(110)	40K
Phase II (two years)	(33)	200K	(35)	200K	(40)	200K

The SBIR policy directives from SBA and the legislative history allow Phase I awards to average up to $50K and Phase II awards up to $500K.

NSF Phase I awards started at $25K in 1977. Phase II awards have remained at $200K since the beginning of the program in 1977 due to funding limitations. We expect them to increase to $250K in FY 1986.

EARTHQUAKE RESEARCH

During FY 84 you requested $19 million for your Earthquake Hazard Mitigation program. Your FY 84 operating plan allocated $17.6 million to that program. Your budget justification indicates that this reduction was the result of "congressional direction".

Question: Could you please indicate the Congressional Committee that directed this reduction in your Earthquake Program?

Answer: The Congressional Committee that directed the reduction in the Earthquake Hazard Mitigation Program was the House Appropriations Subcommitee on HUD-Independent Agencies

The House Subcommittee recommended a cut of $1,500,000 from the requested FY 1984 amount of $2,300,000 for Societal Response Earthquake Research. This recommendation was accepted by the full House Appropriations Committee as indicated in its report on the FY 1984 appropriations bill. This reduced budget became part of the final NSF FY 1984 appropriation.

Question: Could you please provide for the record the expected level of NSF funding for the General Social Survey, the National Election Studies, and the Panel Study on Income Dynamics, for FY 83 through FY 85?

	FY 1983	FY 1984	FY 1985
General Social Survey	$491,596	$ 556,091	$ 552,357
Supplement	16,445		
National Election Studies	494,693	1,575,249	997,367
Separate Planning Grant	81,697		
Panel Study on Income Dynamics	475,000	1,100,000	1,000,000

PLANT DEFENSE MECHANISMS

Question: Please provide a brief summary of the NSF projects and the progress that has been made in the important area of plant defense mechanisms.

Answer: NSF is currently supporting about 100 projects dealing with plant defensive mechanisms. The following is a brief summary of some of the major findings.

It is now known that most species of plants have evolved chemical defense against herbivores. These chemicals can be generally classified as small molecular weight compounds (toxins) which are poisonous to most consumers or larger molecules such as tannins which are not poisonous but form complexes with proteins in the guts of herbivores and reduce protein digestibility. The quality and quantity of these constitutive defenses change within an individual plant as leaf tissue ages. A new leaf has a high percentage of toxins which are poisonous to most insect species. As the leaf ages the percentage of toxins decreases, but the percentage of tannins increases. Researchers also are now finding high variation in these chemicals among leaves on the same tree and among trees of the same forest.

Not only are insects deterred by these chemicals but also some vertebrate herbivores. For example, researchers from the University of Alaska reported in a December 1983 issue of Science that snowshoe hares avoid parts of willow which are high in phenolic (a toxin) concentration.

In addition to an abundance of these constitutive defenses, recently researchers have found that once attached by herbivores, a plant can almost immediately begin synthesizing high concentrations of secondary chemicals at the site of injury. It has also been found that after initial defoliation by insects, reflushed leaves are far more resistant to further attack. A new line of research which will become increasingly important is that these chemicals also apparently provide protection against pathogenic organisms such as fungi and bacteria.

Recently researchers have found that attacked trees produce airborne chemicals which are detected by other trees and result in their also building up chemical fortifications, e.g., the talking trees story which reached the news media last year. Researchers are trying hard to isolate this airborne chemical because of its obvious potential for integrated pest management. Nevertheless, despite all of these chemical defenses, specialized insects have evolved ways of either tolerating them or detoxifying them, so the question has been raised as to what keeps these populations of insects under control. The latest findings suggest that predators may keep herbivorous insect densities at low levels and that plants can evolve ways of making the most efficient use of these predators. For example, many species of plants secrete nectar which is fed upon by ants; and the ants, in turn, kill and eat all herbivorous insects they find on the plant.

Although great progress has been made in the last few years in discovering defensive mechanisms of plants, new discoveries continue to be made. For example there is a species of tropical vine which produces leaf appendages that look like butterfly eggs. The female butterfly when searching for a place to lay her eggs will avoid these vines because she perceives another female has beaten her to the spot; thus the vine is protected from young butterfly larvae.

The research in this large field of plant defensive mechanisms is intensive and highly competitive because many of the discoveries will eventually have wide applicability in forestry and agriculture for the control of plant pests and pathogens.

INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTERS

In describing your Industry/University Cooperative Research Center program you state that about 14 centers will continue to be co-funded during FY 85 and that an additional 5 centers will be initiated. You also note that about a dozen planning grants will be awarded to study the feasibility and viability of new centers. I note that the Foundation requested $3 million for this program in FY 84 and you are again requesting $3 million for the program in 85.

Question: Is it the goal of the Foundation to maintain this level of funding in the future and if so are you creating centers at the appropriate rate so that the private sector can contribute the additional costs necessary to assure that each of these centers is viable?

Answer:

- The goal of the Foundation is to maintain the annual funding of the centers program at around $3 million, adjusting for inflation.

- Increased visibility and success of the program is allowing NSF to reduce its per-center run-out costs and conversely to increase overall industrial support.

- By 1988, the center program should reach a steady-state condition whereby during any one year, 5 new centers will become operational at an NSF cost of $500,000; 5 existing centers will become self sustaining at no cost to NSF; 20 centers will contine in an intermediate stage at an NSF cost of $2,000,000; and 10 centers will receive planning grants at an NSF cost of $500,000; for a total cost of $3,000,000/year.

- The average yearly support for each operational center is projected in 1988 to be $100,000 from NSF and $400,000 from industry and, for each planning grant, NSF will provide $50,000.

- Areas of research and technology being considered for the 5 new centers initiated in FY 1985:

-- Biotechnology
-- Electronics
-- Material Testing
-- VLSI/Sensor Integration
-- Steel Making/Basic Industry

Question: Will you please list the areas of research and technology that you are considering for the 5 new centers that may be initiated in FY 85?

OPERATIONAL CENTERS

Massachusetts Institute of Technology (self sustaining - no NSF funding)

Research on the constitution and forming of polymer and composite structures

Rensselaer Polytechnic Institute (Fourth of five years of NSF funding)

Research to improve the productivity of engineering design; studies in graphic and geometric modeling; development of a geometric data base; finite element graphics studies

University of Massachusetts (Fourth of five years of NSF funding)

Network polymer studies extended lifetime polymer studies; studies of diffusion and foams; chemical modification of surfaces and interfaces

Ohio State University (Fourth of five years of NSF funding)

Sensing variables for robotic arc welding; weld pool solidification studies; laser and laser-arc welding studies; study of of weld strength of steel structure; welding, discontinuity analysis; resistance welding control; micro joining; steel weldability

Case Western Reserve (Third of five years of NSF funding)

Studying the relationship between polymer properties and microstructural phenomena; current projects address glass-fiver reinforced thermoplastics, "liquid crystalline" thermaplastics, synthetic microfibrils, and the polymer gel state

University of Rhode Island (Second of five years of NSF funding)

Research on integrated robot system to develop a data base for industrial applications such as vision systems for robot control and inspection, integration of robotics into production systems, and articulated robotic hands with sensors

North Carolina State University (Second of five years of NSF funding)

Speech processing data communications over power lines; image processing; VLSI algorithms and architectures; computing/communications network architecture

Rutgers University (Second of five years of NSF funding)

Glass formation from multicomponent alkoxide solutions; hydroxylated surface in sol-gel glasses and their use in ultrafiltration; sol-gel derived sealing materials for microelectronic packaging; thin film coatings using sol-gel processes; corrosion of refractories by alternate fuel impurities; toughening of ceramics; strengthening of composite materials; atomic diffusion on glass surfaces.

George Institute of Technology (Second of five years of NSF funding)

Material handling in manufacturing systems, warehouse systems, logistic systems, and automation and sensing

Pennsylvania State University (First of five years of NSF funding)

Basic and applied research specifically relevant to a wide range of ceramic dielectric materials used by industry concentrating on dielectrics for multi-layer ceramic capacitors

Texas A&M University (First of five years of NSF funding)

Facilitate carrying out of multidisciplinary research in all aspects of hydrogen technology, especially for the chemical industry

Worcester Polytechnic Institute (Final year of NSF funding)

Management of technological innovations in the areas of computer-aided manufacturing, decision support systems, and office automation

Planning Grants

New Jersey Institute of Technology - Toxic Waste
University of Washington - Analytical Chemistry
Case-Western Reserve - VLSI System Integration
Arizona State University - Clean Room
Colorado School of Mines - Steel
Northwestern University - Tribology
Arizona State University - Electro-optics
North Carolina State University/Duke-Monoclonal Antibodies

Question: For the record, could you please provide a list of all of the NSF funded centers containing the amount of NSF and the amount of industry/university funding during each year for which the center has been in operation? Please indicate the specific focus of each of these centers.

Funding of Industry/University Cooperative
Research Centers
(In Thousands of Dollars)

	FY 1979		FY 1980		FY 1981	
Univer.	IND	NSF	IND	NSF	IND	NSF
MIT	550	0	600	0	750	0
RPI	120	270	240	300	540	210
U/Mass.	-	-	260	253	375	247
Ohio State	-	-	240	265	410	280
Case Western	-	-	-	-	210	210
Planning Grants		155		432		553
TOTAL	$ 670	$ 425	$1340	$1250	$ 2285	$1500

	FY 1982		FY 1983		Estimate FY 1984	
	IND	NSF	IND	NSF	IND	NSF
MIT	800	0	880	0	950	0
RPI	560	160	660	100	750	0
U/Mass.	450	260	510	154	600	120
Ohio State	500	240	560	160	350	120
Case Western	295	210	345	160	480	110
Rhode Island	825	220	850	220	900	170
NCSU	450	175	500	175	600	150
Rutgers	300	175	360	175	420	160
Iowa	-	-	300	18	0	0
Georgia Tech	-	-	700	200	900	200
WPI	-	-	140	60	250	0
Texas A&M	-	-	160	150	400	200
Penn State	-	-	260	150	400	250
New Centers	-	-	-	-	3,000	1,000
Planning Grants	-	230		278		520
TOTAL	$4180	$1670	$6225	$2000	$10000*	$3000

* In addition, a total of $10M in state funds is also committed to augmenting the funding of a number of centers.

SECURITY CONSIDERATIONS IN R&D

Question: Could you please comment on NSF's current position relative to the classification of scientific research results?

Answer: Hardly any NSF-funded research is classifiable, so few problems exist for the Foundation in this regard. The NSF-National Security Agency informal agreement on cryptology research is working successfully.

The Foundation continues to support the openness of scientific communication to the maximum extent possible, consistent with national security needs of the nation. The Foundation supports the findings and recommendations of the 1982 report of NAS panel on "Scientific Communication and National Security" (the Corson Report), which NSF funded in part.

NSF has been a member of a working group to make recommendations to the National Security Council on treatment of unclassified, but national security sensitive, information.

CONSULTANTS AND EXPERTS

Question: How much do you intend to spend for consultants and experts during FY 84 and FY 85?

Answer: The amounts budgeted for consultants and experts (including the National Science Board) are $600,000 in FY 1984 and $600,000 in FY 1985.

QUESTIONS SUBMITTED BY SENATOR BYRD

In response to a recent meeting in my office, Dr. Edward A. Knapp, Director of the National Science Foundation, agreed to hold a seminar in Morgantown, West Virginia, in order to inform the representatives of the various West Virginia colleges and universities on how better to compete for National Science Foundation Grants. I would like the record to show my appreciation to Dr. Knapp and his staff on their efforts to assist my constituents to become more successful in the competition for National Science Foundation funding, and I would like the attached letter to me from Dr. Knapp to be included in the hearing record.

Question: Would you please provide the total amount of National Science Foundation funding, including the funding level at the Green Bank National Radio Observatory, which has gone to West Virginia for fiscal years, 1981, 1982, 1983, and 1984, and would you please provide a rating among the 50 states as to where West Virginia stands in terms of total National Science Foundation funding?

Answer: The total amount of NSF research funds received by institutions in the State of West Virginia and the State's ranking for FY 1981, 1982, and 1983 are:

(In Millions of Dollars)

	NSF Dollars Received	Ranking Out of 50 States
FY 1981	$15.1	17
FY 1982	15.8	16
FY 1983	17.0	17

The information for FY 1984 will not be available until the end of the fiscal year.

QUESTIONS SUBMITTED BY SENATOR INOUYE

Question: What is the status of your talks with NSF/NASA regarding the Infrared Telescope Facility (IRTF)?

Answer: NSF and NASA signed a Memorandum of Agreement on the operational support of the IRTF in 1983. In accordance with this agreement, NASA will provide long-term operational support and the management. NSF will provide funds on a competitive basis for the development of instrumentation.

Question: What, if any, are your future plans for research on Mauna Kea?

Answer: NSF does not operate any facilities on Mauna Kea. It provides funds for the support of research using telescopes on Mauna Kea through individual research grants. It is providing a total of $3.9M to the California Institute of Technology for installation of a 10-meter, submillimeter wave telescope on Mauna Kea. This telescope will be completed in 1986. Mauna Kea is being considered as a site for a future large optical telescope, if such an instrument is built starting late this decade or in the 1990's.

SUBCOMMITTEE RECESS

Senator GARN. The subcommittee will stand in recess until 10 a.m. on March 8 when we will receive testimony from the Selective Service System, Consumer Product Safety Commission, and the Office of Science and Technology Policy.

The subcommittee is recessed.

[Whereupon, at 11:25 a.m. Thursday, March 1, the subcommittee was recessed to reconvene at 10 a.m. Wednesday, March 8.]

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1985

THURSDAY, MARCH 29, 1984

U.S. SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 10 a.m. in room SD-124, Dirksen Senate Office Building, Hon. Jake Garn (chairman) presiding.

Present: Senators Garn and Abdnor.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

STATEMENT OF JAMES M. BEGGS, ADMINISTRATOR

ACCOMPANIED BY:

- DR. HANS MARK, DEPUTY ADMINISTRATOR
- PHILIP E. CULBERTSON, ASSOCIATE DEPUTY ADMINISTRATOR
- C. THOMAS NEWMAN, COMPTROLLER
- ROBERT O. ALLER, ASSOCIATE ADMINISTRATOR FOR SPACE TRACKING AND DATA SYSTEMS
- DR. BURTON I. EDELSON, ASSOCIATE ADMINISTRATOR FOR SPACE SCIENCE AND APPLICATIONS
- LT. GEN. J. A. ABRAHAMSON, ASSOCIATE ADMINISTRATOR FOR SPACE FLIGHT
- DR. JOHN J. MARTIN, ASSOCIATE ADMINISTRATOR FOR AERONAUTICS AND SPACE TECHNOLOGY
- JOHN W. BOYD, ASSOCIATE ADMINISTRATOR FOR MANAGEMENT

OPENING REMARKS

Senator GARN. The subcommittee will come to order.

Through work conducted by NASA, the United States continues to lead the world in the exploration of space and the development of space technology. NASA's aeronautics research has also been a major factor in our world leadership in the production and export of civil and military aircraft. In addition to our preeminence in space exploration, our investment in NASA also pays off as a direct stimulus to increased national productivity especially in the areas of telecommunications and Earth resources assessment.

Other spinoffs of NASA's technology are less well known but equally important. New products are created, new markets established, and our national security is enhanced. The space agency is truly a national resource of scientific and engineering talent that is unmatched elsewhere in the world.

For fiscal year 1985, you are requesting a total of $7,491,400,000, or $293.9 million over your fiscal year 1984 level, and your R&D request of $2,400,100,000 is 19.3 percent over the fiscal year 1984 level.

Before you make your opening statement, I would just like to make a comment about the structure of the hearing.

Today we will depart from our normal hearing format by dividing the session into two parts. First, we will take testimony from you, Mr. Beggs, and your associates, and then around 11 a.m., we will ask Dr. Philip Chandler of OTA to summarize the findings and recommendations of a 2-day, subcommittee-sponsored workshop on an automated space station.

Mr. Beggs, I see that you have an 11-page opening statement; would you please proceed.

NASA'S FISCAL YEAR 1985 BUDGET REQUEST

Mr. BEGGS. Thank you, Mr. Chairman.

I am pleased to have this opportunity to discuss President Reagan's proposed budget for NASA for fiscal year 1985. The President has proposed a NASA budget of just under $7.5 billion, of which $2.4 billion is for research and development; $3.6 billion for space flight, control, and data communications; $160 million for construction of facilities; and $1.3 billion for research and program management. NASA's proposed budget includes an overall increase of $274 million, a little less than 4 percent over our present plan for fiscal year 1984.

Although modest in growth, this budget is bold in spirit and farsighted in vision. It reflects the President's commitment to a forward-looking and imaginative initiative for the Nation, a permanently manned space station as the next logical step in space. Such a facility will give us a permanent presence in low Earth orbit by the early 1990's and will be the cornerstone of our activities in space through the end of the century and beyond.

For fiscal year 1985, we are requesting $150 million for the space station program. These funds represent the minimum amount sufficient to begin an endeavor of this importance and scope, and necessary to assure an efficient and well-conceived space station program.

In addition to the space station initiative, the fiscal year 1985 budget contains a positive step in terms of program outlook and institutional stability. The President's 5-year projections include real growth in NASA activity of 1 percent per year over the 1986–89 period.

In fiscal year 1985, the space transportation systems budget provides for 11 Space Shuttle flights. The STS flight rate will continue to increase toward a rate of 24 per year by fiscal year 1989, when we expect to launch about 20 from KSC and the remainder from the Vandenberg Air Force Base. The first flight from Vandenberg is now planned for fiscal year 1986.

In view of the continuing successful performance of the Shuttle, I believe that the investments that we have made in the Space Shuttle system will pay off handsomely in the future. The Shuttle has become the Nation's primary space launch system. Because of this, we are continuing the program to produce the spare parts required to assure a launch capability that is so important in both the civil and the national security related sectors. We are also continuing the structural spares program; this will make it possible to assemble another orbiter should the decision be made to take that step.

In our fiscal year 1985 budget request for space science and applications, we are proposing several new important initiatives—the upper atmosphere research satellite, planned for launch in 1989, and the Mars geoscience/climatology orbiter, planned for launch in 1990. The proposed budget will also continue to support development activities for Space Telescope, Galileo, the Venus Radar Mapper, and the Gamma Ray Observatory. In view of recent private-sector proposals, we have decided not to request funding to support an advanced communications technology satellite flight demonstration, but to continue the necessary related technology activities on the ground.

The fiscal year 1985 budget supports a strong aeronautics and space research and technology program, a tracking program which would continue to support all NASA flight programs, a facilities program which provides for essential needs, and a research and program management budget which supports a stable civil service complement.

I believe that the fiscal year 1985 budget is an excellent program that will continue to insure our Nation's leadership in space and aeronautics in the coming years.

Mr. Chairman, having summarized the important highlights of our budget request, I would be pleased to respond to questions.

Thank you very much.

[The statement follows:]

STATEMENT OF JAMES M. BEGGS, ADMINISTRATOR

Mr. Chairman and Distinguished Members of the Subcommittee:

It is a pleasure for me to appear before this Subcommittee to present President Reagan's budget request for NASA for FY 1985. The total Agency request is $7.5 billion, of which $2.4 billion is for Research and Development; $3.6 billion for Space Flight, Control and Data Communications; $160 million for Construction of Facilities; and $1.3 billion for Research and Program Management. A chart summarizing NASA's FY 1985 budget request is appended to this statement.

In his State of the Union message to Congress, President Reagan outlined a bold new initiative for the United States that will maintain and ensure, during the decade of the 1990's and beyond, our hard won position of leadership in space. The President's initiative is a permanently manned Space Station to be in operation within a decade. As a fundamental element of his vision for this Nation's future, the Space Station will:

- reflect and contribute to America's commitment to research, technology and productivity;
- be a peaceful, visible demonstration of U.S. strength and commitment to leadership;
- implement the clear direction the civil space program has needed and found in the President's National Space Policy set forth in July of 1982.

The time for Space Station is ripe -- the agenda for tasks which can be undertaken and enhanced using the unique capabilities of the Space Station is full, and both U.S. industry and the NASA institution are fully prepared to implement the President's initiative. The Station is, I believe, the next logical step in space.

The idea of a Space Station Mr. Chairman, is not new; however, a combination of circumstances makes the President's initiative especially timely. The most important reason to begin a Space Station now is that the Space Shuttle is approaching fully operational status. After a ten year development program, we now have the capability to reach low Earth orbit routinely. To maximize the unique advantages provided by the environment of space, we need to establish a permanent presence that enables us to work in space full time and fully utilizes the capabilities of the Space Shuttle. Without the capability of the Shuttle, it would be impossible to establish the "more permanent presence in space" referenced by the President on July 4, 1982, in his National Space Policy statement. A second reason is that the operations we have conducted with the Shuttle have stimulated great interest in the private sector to look toward investments in future space activities. The construction of a Space Station is necessary to create the facilities that will greatly encourage such investment, and to stimulate new technology that will spin off into the U.S. economy. Finally, the Shuttle has also stimulated great international interest in the U.S. Space Program, as evidenced by the overwhelming reception of the "Enterprise" in Europe last summer and the recent highly successful flight of the Spacelab. As the President stated, we will plan the Space Station program in such a way that it will be possible for our friends and allies around the world to participate with us in taking this major step.

Based upon NASA and industry analyses over the past 18 months, the Space Station program will serve a number of functions, such as:

- a laboratory in space, for the conduct of science and the development of new technologies;
- a permanent observatory, to look down upon the Earth and out at the universe;
- a transportation node where payloads and vehicles are stationed, processed and propelled to their destinations;
- a servicing facility, where these payloads and vehicles are maintained, and if necessary, repaired;
- an assembly facility where, due to ample time on orbit and the presence of appropriate equipment, large structures are put together and checked out;
- a manufacturing facility where human intelligence and the servicing capability of the Station combine to enhance commercial opportunities in space;
- a storage depot where payloads and parts are kept on orbit for subsequent deployment; and,
- a staging base for more ambitious future missions.

Perhaps more important than any of these individual points, however, is that the Space Station, in my belief, will lead to important activities and functions that we cannot even predict today. The Space Station will represent a fundamentally new and versatile capability to support activities in space in the decade of the 1990's and beyond.

While definition of a specific Station configuration is yet ahead of us, it might be appropriate to describe conceptually what NASA now considers the Station to encompass. A Space Station is conceived as a multi-purpose, permanent facility in low-Earth orbit, that is comprised of both manned and unmanned elements and that significantly enhances the efficiency of our operations in space. As we now see it the Station would consist of a manned base and associated unmanned platforms, oriented to the needs of both science and applications missions, and man-tended from the base. The base and the platforms would be launched in modular sections carried into orbit in the cargo bay of the Shuttle. The Shuttle would also be used for logistics resupply and crew rotation. We believe that the enabling capability of the Space Station can be in place within a decade and for approximately $8 billion in today's dollars.

In FY 1984, in-house definition and supporting study efforts will be continued on Space Station configuration, requirements and advanced technology. The NASA Space Station activity has been managed and coordinated by the Space Station Task Force which has done an excellent job here at NASA headquarters. Recently I designated the Johnson Space Center as the lead center for the Space Station program. Due to the broad nature of the program I foresee roles for all of the NASA centers and we plan to capitalize on the expertise which exists across the institution. Last month we designated lead and supporting center roles for Space Station advanced technology development. I plan to expeditiously establish a headquarters program organization and make the remaining decisions on field center roles and missions.

During this next year we will also be actively involving industry, universities, other government agencies and foreign countries to incorporate their ideas, consider their requirements and plans for their potential investments. There is a great deal of interest by all of these organizations in the potential use of the Space Station. At the request of the President, earlier this month I traveled to Europe, Japan, and Canada to solicit views on the Space Station and ascertain the level of foreign interest in participating in the program in a meaningful way. I found both the level of interest and the potential for meaningful participation to be extremely high.

For FY 1985 we are requesting $150.0 million for the Space Station program. We have planned an extensive definition effort with sufficient resources to assure that the program, when hardware development is initiated, will be thoroughly defined, responsive to user requirements, and based on the proper mix of man and machine, incorporating the most advanced technology available. These definition efforts will include an automation plan to utilize the best of both manned and unmanned modes to achieve optimum productivity at the Station. The FY 1985 effort will include ongoing assessment of Space Station utilization requirements and initiation of a number of advanced development test beds to evaluate high leverage space station technology options. The FY 1985 program will comprise the first year of this detailed engineering definition effort which will provide the basis for commitment to the final design for the construction of the Space Station. Mr. Chairman, we are very enthusiastic about the President's initiative, and look forward to working with you to make this vision a reality.

The FY 1985 budget contains a positive step in terms of program outlook and institutional stability. The President's five year projections include real growth in NASA activity of one percent per year over the 1986-1989 period. The projections do not merely provide for the future year costs of programs proposed for the budget year, as was the previous practice, but include an allowance for the future new initiatives that are essential to a vital program of leadership in Space and Aeronautics. This approach gives us an opportunity to plan and implement a forward looking program and provides added incentive to our people to make it happen.

Mr. Chairman, making the Space Shuttle fully operational and cost-effective remains NASA's number one priority. I am very pleased to report that the Space Shuttle has continued to perform splendidly and that there have been major achievements in the past year. Perhaps the most important one was the first flight of Spacelab. The Spacelab-1 flight demonstrated that people in space can perform very complex experiments and that real-time corrections and fixes to the experiments can greatly enhance our ability to get important scientific results. The results of Spacelab-1 confirmed the capability of scientists in space to perform valuable experimental work and gave credence to our plans for scientific utilization of the Space Station. The ten-day mission met all of its verification objectives and obtained excellent scientific results. The flight was also an extremely important example of how complex international collaborative efforts can be successfully carried out. Mr. Chairman, the Spacelab was funded and built primarily by the European Space Agency and one of the people on the first Spacelab flight was a European scientist. The Spacelab flight drew a great deal of favorable attention in Europe and, there is no doubt in my mind, it contributed to strengthening our relations with our European allies during a particularly critical time last year.

Since our appearance before you last year, we have had four successful Shuttle flights. During these flights, we made the first night launch and landing; accomplished the first landing at the Kennedy Space Center; and flew the first woman (Sally Ride), the first two blacks (Guy Bluford and Ron McNair) and the first two payload specialists including a foreign scientist (Ulf Merbold). We are now looking forward to the selection of private citizens as passengers on future Shuttle flights, possibly as early as 1985.

We also conducted our first extra-vehicular activity from the Shuttle and it was very successful. We have learned much about the operational environment of the payload bay and it is our intent to put this knowledge to good use. STS-41B, the Challenger flight launched February 3, 1984, successfully conducted the first untethered extra-vehicular activity to test the new Manned Maneuvering Unit. However, on the same flight two reimbursable communication satellite missions experienced anomalies. One of the affected satellites was for Western Union (Westar VI) and one for the Indonesian Government (Palapa-B2). These missions were successfully launched out of the Orbiter Bay, but because of an anomaly believed to be in the commercially provided spacecraft's Payload Assist Module (PAM-D), the spacecraft did not achieve proper orbit. The causes of these failures are under investigation.

On the next Shuttle flight (STS-41C) we will retrieve a failed satellite (the Solar Maximum Mission satellite), bring it to the Shuttle and attempt to make the necessary repairs. If the repairs are successful, we will redeploy the satellite. If they are not, we will bring the satellite back to the ground for repair and redeploy it on a subsequent Shuttle mission. These operations are extremely important, not only because they will permit the extension of the lifetime of this valuable satellite, but also because they will be a dramatic demonstration of the great capability that is inherent in the Shuttle system.

Including the SMM repair mission six or seven Shuttle flights are scheduled for FY 1984. These flights include the first dedicated Department of Defense mission; the first flight of Space Shuttle Orbiter "Discovery;" the first autoland; and the deployment of several commercial communications satellites. A number of science and technology payloads will be flown, including the Large Format Camera and the Shuttle Imaging Radar. These missions will utilize all three of the delivered Space Shuttle Orbiters: Columbia, Challenger, and Discovery. Atlantis, the fourth orbiter, is scheduled for delivery toward the end of 1984.

In FY 1985, the Space Transportation Operations budget provides for 11 Space Shuttle flights, including three dedicated Spacelab missions; completion of the TDRSS constellation of three orbiting spacecraft; the deployment of eight communications satellites; the first retrieval of a Shuttle-deployed spacecraft, the Long Duration Exposure Facility; transition from the conceptual phase of the McDonnell Douglas electrophoresis experimentation to small prototype production plants that will produce products in quantities sufficient to begin testing and marketing; and continued use of the Shuttle by the Department of Defense. The STS flight rate will continue to increase toward a rate of 24 per year by FY 1989, when we expect to launch about 20 from KSC and the remainder from Vandenberg Air Force Base. The first flight from Vandenberg is planned for FY 1986.

In order to make certain that the Space Shuttle can satisfy the performance requirements and timelines demanded in the future, the FY 1985 proposed budget includes a program to enhance the performance of the Space Shuttle propulsion system. The major portion of this program is devoted to improving the Space Shuttle Main Engine system, first by increasing the reliability of the system and later by making substantial performance improvements through the incorporation of advanced technology components. This will be done by a combination of fine tuning of our designs on certain critical elements of the engine such as bearings and seals, and by taking longer-range steps to decrease operating temperatures and pressures under sustained flight at maximum throttle setting. Increases in the engine program are due both to this investment in improved durability and increased investment in spare engines and components. In addition to engine improvements, we are also taking steps to improve the performance of the Solid Rocket Boosters through the use of composite materials to make filament wound booster cases. Shuttle capability will also be enhanced by the continued NASA/Air Force development of the Shuttle/Centaur upper stage, which we will use to launch the Galileo and International Solar Polar missions in 1986.

In view of the successful performance of the Shuttle during the past year, I continue to believe that the investments we have made in the Space Shuttle system will pay off handsomely in the future. The Shuttle has become the Nation's primary space launch system; because of this, we are continuing the program to produce the spare parts required to assure a launch capability that is so important in both the civil and the national security related sectors. We are also continuing the structural spares program; this will make it possible to assemble another orbiter should the decision be made to take this step. For these and many other activities in Space Transportation Systems, we are requesting $3166.0 million in FY 1985.

Mr. Chairman, I would now like to turn to NASA's more traditional programs and provide you with a brief report of our accomplishments of the last year and also give you a synopsis of our plans for the future. In our Space Science and Applications program, the most important achievement was the successful launch of the Infrared Astronomical Satellite (IRAS), a cooperative project of the United States, the Netherlands and the United Kingdom. The mission was launched in January, 1983, and remained operational through December, 1983. A number of important discoveries have been announced, but in my opinion two are particularly outstanding. One is the discovery of about 20,000 new asteroids -- about ten times as many as were previously known -- with diameters between one and ten miles. This is a truly astonishing number and it is a result that was generally not expected by the astronomical community. Another equally important discovery of IRAS was that the star Vega is apparently surrounded by a dust cloud that is a prototype for the kind of planetary system that surrounds the Sun. This is the first positive evidence that there may be other stars in our galaxy that have planetary systems similar to those of the Sun. The large quantity of data that has been generated by the IRAS is now being analyzed. I am confident, Mr. Chairman, that equally significant discoveries will be made in the coming months as we look more carefully through the measurements that have been made by this satellite.

In our FY 1985 budget request of $1371.5 million for Space Science and Applications, we are proposing several new important initiatives. One is the Upper Atmosphere Research Satellite, which is planned for launch in 1989, and will provide detailed measurements of the physical and chemical properties of the upper atmosphere. A particularly important aspect of the Upper Atmosphere Research Satellite program is that it will provide information about the molecular species in the upper atmosphere that determine the radiation transport properties in that arena. These properties, in turn, have a strong effect on the world's weather patterns, but perhaps more significantly on the long-term changes that may affect the eventual ability of the Earth to continue to support life. I believe that the Upper Atmosphere Research Satellite is the most significant new initiative in atmospheric science in many years, and I strongly recommend that you support the program.

Another new initiative is the Mars Geoscience/ Climatology Orbiter planned for launch in 1990. The mission will be designed to obtain new geophysical and geochemical information about Mars, especially near the polar regions where not much data is available. This mission is the highest priority of a number of relatively low-cost missions referred to as "Planetary Observers," which were recommended by the Solar System Exploration Committee to provide a more intensive investigation of specific questions in planetary science. I believe the approach we are taking on this mission will be both an efficient and cost-effective method of planetary exploration.

For several years now, we have developed plans for a program to fly an Advanced Communications Technology Satellite called ACTS which is designed to develop advanced communications switching, processing, and antenna technologies; and to regain U.S. technological leadership in this important field. This program was designed to be executed in close collaboration with the communications satellite industry. It has been our purpose, consistent with the President's policy to encourage private sector commercial investments in space, to formulate our programs in such a way as to make it possible for private investors to take part in space activities. The ACTS program is an example of this policy. Recently, private companies have made proposals to build satellites with their own money which will do some of the things that we had planned to do with the ACTS satellite. In view of this development, we have decided not to request funding to support a flight demonstration which had been planned in the ACTS project, but to continue the necessary related technology activities on the ground.

In addition to the new initiatives, the proposed FY 1985 Space Science and Applications funding will continue to support a well-balanced and productive program in many areas of science. For example, the Hubble Space Telescope development activities will be continued, leading to a launch during the second half of 1986; the Galileo development activities will be continued, leading to a launch in 1986; and development will continue on the Venus Radar Mapper and the Gamma Ray Observatory, both of which are scheduled for 1988 launches. We will continue development of Spacelab instrumentation and other Shuttle payloads spanning an increasing spectrum of research and development. The FY 1985 budget also continues support for Life Science and Microgravity Science and Applications, as well as a strong and diverse supporting research effort which provides the foundation for the total NASA science and applications program.

NASA's FY 1985 proposal of $9.5 million for Technology Utilization will allow continued effort to transfer NASA-developed technology to U.S. industry, the public and Government agencies, at a level made possible by the FY 1984 Congressional augmentation.

NASA is requesting $342.4 million in FY 1985 for Aeronautics Research and Technology to provide the technology advances critical to the continued preeminence of U.S. civil and military aviation. The planned program provides a solid base of fundamental research in the aeronautical disciplines --

aerodynamics, materials and structures, propulsion, and controls and human factors -- and systems research directed at the interactions among components and subsystems. Vehicle-specific areas of NASA research include subsonic aircraft, high performance supersonic cruise/maneuverable aircraft, and rotorcraft. Current activities are directed at improved performance, safety, and reduced costs of aircraft and operational systems.

Our FY 1985 request continues important new initiatives begun in FY 1984 in numerical aerodynamics simulation, advanced composite structures technology, and technology for the next generation of rotorcraft. In the Numerical Aerodynamic Simulation (NAS) program, the world's first Cray 2 high-speed processor will be delivered to Ames Research Center in December 1984 and installed in the NAS processing system network. The NAS system is expected to be initially operational in 1986 and fully operational in 1987, providing the U.S. aerodynamics community with an increased computational capability four to six times the current capabilities. The Advanced Composite Structures Technology (ACST) program is developing technology needed to incorporate composite primary wing and fuselage structures into large, transport-type aircraft by the 1990's. Full use of composites in primary airframe structures can potentially reduce total aircraft weight by up to 15 percent, significantly lowering operational costs. The FY 1985 effort directed at technology to increase speed for the next generation of rotorcraft consists of a joint NASA/Defense Advanced Research Projects Agency (DARPA) flight test program of the X-wing rotor concept utilizing NASA's Rotor Systems Research Aircraft.

During FY 1985, the Advanced Turboprop (ATP) program activities will continue to develop the broad-based supporting technology required for advanced high-speed turboprop propulsion and will include advanced concepts and configurations such as counter-rotation propeller systems. These activities will be implemented in a manner that maintains the options to support a potential future systems integration/flight research phase to evaluate large-scale advanced turboprop structural, acoustic, and aerodynamic performance. Also during FY 1985, the general aviation/commuter engine technology effort will continue to serve as a focus for small engine component research that is aimed at 25 percent improvement in small engine fuel efficiency.

The FY 1985 Space Research and Technology request of $150.0 million provides a broad base of long-term, high-risk, high-payoff technology essential to NASA's role of maintaining U.S. preeminence in space. This investment supports Agency goals of improved operational effectiveness of the space transportation system and extended capabilities for U.S. science and applications missions. Further, it provides support to the technology needs of the expanding number of military and commercial space users. Of particular significance in this year's NASA program are advanced technology capabilities derived from ongoing research which will be focused in support of Space Station definition efforts.

NASA is requesting a total of $811.0 million for the Space Tracking and Data Systems program in FY 1985. These funds will provide for the continuation of the vital tracking, command, telemetry, communications, and data processing support to meet the requirements for all NASA flight programs. Tracking and acquisition of data functions are presently accomplished through the use of a worldwide network of ground stations and by the first of a system of three Tracking and Data Relay Satellites.

This first TDRS was launched in April 1983, and was deployed into an elliptical orbit as a result of an anomaly during the second stage burn of the Air Force-provided Inertial Upper Stage (IUS). Through a series of orbital adjust maneuvers, utilizing the spacecraft's small thrusters, the TDRS-1 was boosted to a geosynchronous orbit.

In the past year, TDRS-1 has successfully supported Landsat-4, the STS-8 mission, the STS-9/Spacelab-1 mission, and the STS-41B mission. The Spacelab mission received 99 percent of the requested mission data acquisition support. While we are still working with the USAF to resolve the IUS problem, we hope to launch the next TDRS in early 1985, with the third TDRS launch to follow later in 1985.

NASA's FY 1985 Construction of Facilities request of $160 million will provide for minimum essential facility needs, with particular emphasis on exploiting the Shuttle's capabilities, enhancing key research facilities for aeronautics and space technology development, and improving space communications capabilities. It includes provision for a new facility at the Ames Research Center to house the Numerical Aerodynamic Simulation (NAS) activities now under development, as well as funding to complete construction of two key facilities at the Kennedy Space Center -- a solid rocket booster assembly and refurbishment facility and a logistics facility to be used in conjunction with the Shuttle Processing activities. As part of NASA's Construction of Facilities request, we are requesting an increase in the funding limits for individual projects in the minor facilities program.

Mr. Chairman, I am very pleased to report that the NASA institution is fully prepared to support the President's budget initiatives. Perhaps the most important factor is that with the support of this Administration and the cooperation of the Congress, the decline in the civil service complement assigned to NASA has been stopped. For the past two years, the NASA Civil Service complement has been stable at approximately 22,000 positions and our FY 1985 Research and Program Management budget request of $1331.0 million will allow us to continue with this number of people into the future. This stability has had the important consequence that in 1983 we were able to hire almost 600 recent science and engineering graduates. With the civil service complement we are proposing, we hope to be able to hire several hundred new science and engineering graduates next year as well. There is no doubt whatsoever that our ability to bring in so many new people will have a profound, positive influence on the future of NASA. The importance of this in-house capability has been well-recognized in many studies, including the recent one carried out by the Office of Science and Technology Policy under the chairmanship of Dr. David Packard. This study explicitly recognized the importance of healthy Federal laboratories to the economic health and national security of the U.S. and we endorse and support its recommendations.

An Agency-wide Productivity Improvement and Quality Enhancement Program emphasis last year is producing several long-term initiatives for streamlining our administrative processes, improving contract management, and enhancing support for science and mathematics education.

In addition to people, we must also look to the adequate operation and maintenance of our physical plant. Accordingly, NASA's FY 1985 R&PM request includes an increase of $10 million to augment day-to-day recurring operational and preventive maintenance activities. I believe this is extremely important if we are to execute the programs that we have in mind.

Conclusion

Mr. Chairman, I have attempted to provide you and the Members of the Subcommittee with a short overview of the Administration's FY 1985 program for NASA. I believe that it is an excellent program that will continue to ensure our Nation's leadership in space and aeronautics in the coming years. The program also provides a new vision for the future which is both realistic and farsighted. I would be remiss, Mr. Chairman, if I did not take this opportunity to thank this Subcommittee for its continued interest and support. Without your help and leadership over the past years, it would not have been possible for us to formulate the program that I am presenting today.

Mr. Chairman, I would now be pleased to answer any questions that you and other Members of the Subcommittee might have.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

BUDGET SUMMARY
(Thousands of Dollars)

	Budget Plan		
	1983	1984	1985
RESEARCH AND DEVELOPMENT	1,902,500	2,028,200	2,400,100
Space Station a/	(4,000)a/	(14,000)a/	150,000
Space Transportation Capability Development	415,500	431,700	361,400
Space Science and Applications	1,060,100	1,134,000	1,371,500
Technology Utilization	9,000	9,000	9,500
Aeronautical Research and Technology	280,000	302,300	342,400
Space Research and Technology	124,500	137,000	150,000
Tracking and Data Advanced Systems	13,400	14,200	15,300
SPACE FLIGHT, CONTROL AND DATA COMMUNICATIONS b/	3,633,010	3,775,300	3,600,300
Shuttle Production and Operational Capability	1,725,810	1,649,300	1,465,600
Space Transportation Operations	1,421,700	1,452,000	1,339,000
Space & Ground Network, Comm. and Data Systems	485,500	674,000	795,700
CONSTRUCTION OF FACILITIES	103,530	155,500	160,000
RESEARCH AND PROGRAM MANAGEMENT	1,197,400	1,258,500	1,331,000
TOTAL	6,836,440	7,217,500	7,491,400
OUTLAYS	6,663,885	7,068,200	7,370,000

a/ In FY 1983, the Space Station Activity was included in Space Transportation Capability Development. In FY 1984, $6.0 million was included in Space Transportation Capability Development, $2.0 million in Space Science and Applications and $6.0 million in Space Research and Technology.

b/ Prior to FY 1984, these programs were included in the Research & Development appropriation.

FAREWELL TO GENERAL ABRAHAMSON

Senator GARN. Thank you, Mr. Beggs.

General Abrahamson, I would like to take this opportunity to congratulate you on your new assignment. You certainly have administered the Shuttle program during a very critical stage of its development, and I would like to thank you for your dedication and your diligence on that program. I expect I will be seeing you in the future when I put on my DOD appropriations committee hat. I also serve on that subcommittee, not as chairman, but I do serve on that subcommittee, so I do look forward to working with you there.

General ABRAHAMSON. Mr. Chairman, I would like to say for the record, thank you; and thank you, obviously, for the committee's support of the overall program for many years. But I would like to say for the record that it has been a great privilege to work with the NASA team. Thank you.

PASSENGERS ON SHUTTLE

Senator GARN. Mr. Beggs, on page 5 of your prepared statement, you note that you are looking forward to the selection of private citizens as passengers on future Shuttle flights, possibly as early as 1985. I thought you ought to know for the record that I also look forward to the initiation of flights for private citizens, and I am sure you would have been terribly disappointed if I didn't continue my previous hearing comments by making some note of that fact.

I only really have one update from what I have done in previous budget hearings in putting in my age, rank, flight time, and all of those things. I felt there was one more base that I need to cover, and it has caused me some difficulty over the last few months. Last summer, I decided, well, if this really works out and they really let me go, I certainly wouldn't want them to turn me down for any physical reasons.

So I started a regular running and exercise program, and I would like you to know that my resting pulse rate is down to 45, my blood pressure is 110 over 65; still no glasses at the ripe old age of 51, and I can run 10 in under 50 minutes now, and I am 10 pounds lighter than when I played football in high school. So as far as propellants and so forth, I am minimizing the weight you would need to carry. I don't think you can consider flunking me on a physical basis. I have sick hair follicles, but other than that [laughter] I have no problems that I am aware of. So I just wanted you to know when we get around to this, I don't think I have left any bases untouched. I think I am prepared and ready to go, and I would also say one other thing: That there are other agencies under this subcommittee's jurisdiction. One of them is the National Science Foundation, and they certainly wanted me to go down to some of their remote facilities, which I did, and review all of their activities and see how they're spending money. NASA is the only one who has yet to physically let me test or at least observe how we are spending their moneys, so I wouldn't want NASA to be the only agency under the subcommittee's jurisdiction who has denied me the privilege of kicking the tires to see if we are really getting our value for the dollar.

Mr. BEGGS. We are going to keep that all very much in mind. [Laughter.]

POSSIBLE SUPERCOMPUTER SUPPORT TO NSF

Senator GARN. I intend to see that you do not forget.

Once again this year, I would like to thank you for the assistance you and your staff have given the subcommittee in preparing the real time budget analysis system for the committee. NASA has been very, very helpful in this effort, and I expect that the end result of that process will help both of us.

As you know, NSF is undertaking a new initiative in fiscal year 1984 aimed at providing the academic research community with better access to supercomputers. In the course of surveying the current availability of supercomputers, NSF has determined that in the short run, they may not be able to procure adequate supercomputer time from existing university computer centers. Because of this situation, the subcommittee has been discusssing, with you and NSF, the possibility of NASA providing access to one or more of its supercomputers on a reimbursable basis. We have also talked to Dr. Knapp and NASA officials about the possibility of allowing NSF to pick up the purchase option on a NASA-leased supercomputer and, subsequently, sell it to a university center at a discount.

Could you have your staff look into how NASA might be of assistance to NSF and the research community on this issue and, if possible, get back to us by the end of April?

Mr. BEGGS. Yes, sir, we certainly will. We believe that's an important activity. We certainly will cooperate.

[The information follows:]

NASA has received a request from the National Science Foundation regarding the possibility of NASA providing access to one or more of its supercomputers on a reimbursable basis. We are currently investigating the availability of computer time and the network communications required to support the remote access. We will inform the NSF and your subcommittee of our findings when this assessment is complete.

SHUTTLE OPERATIONS ACCOUNT

Senator GARN. In our fiscal year 1984 appropriations bill, we established a new account structure which separated R&D from space flight control and data communications. We took this action because your existing appropriations account structure no longer accurately reflected NASA's mission. Particularly, we noted the growing portion of NASA's budget devoted to Space Shuttle operations. While these activities were, in the past, funded through your R&D account, they obviously were not an R&D activity.

You have now been operating 6 months under this new account structure. Have you experienced any problems with this change to the new type of accounting, and would you recommend any changes in it at this time?

Mr. BEGGS. No, sir. The usual clerical problems of establishing those new accounts, but I think they're well established now. The only changes we expect to make in the future will be as we move more toward the operational phase of things like the Spacelab and other things which will become operational. We would include those accounts, as well, in the operational account.

SPACE SHUTTLE SPARES

Senator GARN. In your opening statement, you note the agency is continuing the structural spares procurement program. This will make it possible to assemble another orbiter should the decision be made to take that step.

Based on your current spares inventory and the assumed spares that will be purchased under your fiscal year 1985 budget, what additional spares have to be procured in order to assure that a fifth orbiter could be effectively assembled?

Mr. BEGGS. Well, we are buying, I think, spares at almost every category now for the operational program, so we could draw down, depending on how we assess the requirement for support of our flight rate, we could draw down on the other spares that we are buying to assemble. Things like the ducting and the tubing and the other things which have to be fabricated and formed as you make the vehicle, we are not, of course, laying in spares, but on all the other items, I think we do have a spares backup.

Assuming we were to start, let's say, next year on the construction of the fifth orbiter, we would, I think, have to assess how many additional spares we would have to buy in order to back up the operational requirement, but we could, as I say, draw down on what we are buying to make that assembly.

Senator GARN. You probably would be planning, then, if you didn't need additional spares for fiscal 1986, for the additional ones?

Mr. BEGGS. Yes, sir.

SHUTTLE MAIN ENGINE

Senator GARN. Last year you conducted a detailed review and assessment of the Space Shuttle main engine program which was prompted by the preflight delays of STS-6. This assessment revealed that there was an inadequate logistics base of engines and spare parts to insure an uninterrupted operational program. What plans have you made since that time to correct this problem, and what are the associated fiscal year 1984 and fiscal year 1985 costs?

Mr. BEGGS. We decided to add four additional engines to the production line, and those four engines will, we think, give us an adequate backup.

We also are procuring long-lead pieces of parts for three additional engines beyond the fourth. The costs associated with that were a $25 million increase in fiscal year 1984 and $52 million increase in fiscal year 1985, which is included in this budget. The total costs of all those SSME engines, including the spare engines I have described in 1984, is $153 million; that is the total account, and $172 million in 1985.

STATUS OF FILAMENT-WOUND CASE

Senator GARN. The development of a filament-wound case for the solid rocket boosters was initiated by NASA in order to increase the payload capability of the Space Shuttle for high-performance missions. Originally, the weight reduction was estimated to result in a payload capability of about 6,000 pounds.

Based on your latest engineering data, what payload improvements does it appear that you will now be able to achieve in the filament-wound case?

Mr. BEGGS. It looks like about 4,600, and we have been holding at that 4,600 for some months now, so I think that looks pretty good.

Senator GARN. This increased payload capacity, what additional augmentations will the Shuttle require in order to meet its 32,000-pound payload design requirements?

Mr. BEGGS. Well, in addition to the filament-wound case, we will operate the main engines at 109 percent to achieve that. As you know, we have had some problems associated with the operation of 109 percent concerned with the life of the engines. There is no safety of flight issue concern here, but when we operate at the higher power levels, we do get excessive wear, and that is one of the things we are working on right now in an effort to improve that problem and increase the durability of the engine and thus lengthen the overhaul cycles.

Senator GARN. What level of funding have you requested for the filament-wound case for fiscal year 1985?

Mr. BEGGS. $74 million.

Senator GARN. What is your current estimate as to the number of the reuses that might be expected from the filament-wound case versus the steel case?

Mr. BEGGS. It is an unknown right now. We need to run some tests to see whether there is deterioration in the case as a result of flight and firing. We will be doing that, and, as a matter of fact, the contract will be running some tests later on this calendar year and we will start to accumulate experience as to how well they hold up after firing, starting late this year. But I doubt that we will know this answer completely for probably several years after we have operated with the case a number of times.

Senator GARN. What is your estimate of the production cost of the filament-wound case versus steel?

Mr. BEGGS. It looks like they are going to be a little more expensive than the steel cases, although again, we are not totally sure of those costs. It adds about $2.5 million more per set for two, so the cost of a new set of SRB cases goes from about $14 million, a little over $14 million for the steel, to $17 million for the filament wound.

Senator GARN. Are you still on schedule in terms of schedule and costs?

Mr. BEGGS. We are tight. We have been watching this one very closely because it is tight. We want to have them available for the first flight out of Vandenberg so we can get that test in, and we are going to be very tight against that schedule.

But we are still holding those dates, and there is, I think, maybe a 60–40 chance we will meet them.

SOLID ROCKET BOOSTER STATUS

Senator GARN. What is the status of your program to develop a larger main chute for the solid rocket boosters?

Mr. BEGGS. We will fly the first of those larger chutes, 138-foot chute, on the next flight on one of the booster cases. Then after that, we had planned to use them both on a continuing basis. It's been tested, it works well, and they are certified.

Senator GARN. Would you expect to minimize the water damage, then?

Mr. BEGGS. We hope that it will significantly improve the problem we have had in the water damage, and we will get some experience, as I said, with the one we will fire or we will install this next flight.

Senator GARN. On the STS–8 flight, there was concern about the amount of erosion on one of the solid rocket nozzles. Your budget justification notes that modifications in manufacturing procedures are being evaluated as possible solutions to these recent problems.

Since the time that your statement was written, have you determined the actual cause of the problem, and do you have a recommended solution?

Mr. BEGGS. We think we know the cause of the problem. In fact, we are almost certain we know the cause of the problem. It was a problem that really had several sources. When you lay up these nozzles, you have to put them through a cure cycle, and that cure cycle has been under evaluation and changeover time. Unfortunately, we probably moved a little too far in the direction of increasing production and have gotten ourselves into a little bit of trouble on the durability of the nozzle, so it was a combination of the cure cycle and the fact that we got a lot of material, the carbon filament material, which had a higher volatile content than normal.

No, that is wrong. Let me try that again.

We set up a specification originally to buy this material, and while some of the material comes in within specification, it is at the high end of the specifications, so it doesn't have a higher volatile content in terms of what we specified. As luck would have it, it was coming in on the average with a lower, mid-range of the specification. We got a lot which was at the high end of the specification in volatile content for that particular nozzle, and that was the result of the spalling or erosion. It was a combination of both those things. The material which was at the high end of the specification of volatiles and a change in the cure cycle. Again, as luck would have it, on that particular set of nozzles they lost the vacuum on the shroud that encases those nozzles when they are in the cure process.

So all of those things contributed to our problem.

We think we have corrected them all now, and we have had no further problem of the type we experienced on STS–8, although we have seen and continue to see some minor erosion from time to time.

Senator GARN. Senator Abdnor?

Senator ABDNOR. Thank you, Mr. Chairman.

SPACE STATION

I was just interested in this. You hear a lot about the space station. Tell me about this space station, Mr. Beggs. What does it do for us, and why do we need one?

Is this space station going to represent a lot of prestige, leadership? What are we really going to get out of this at the time when we are talking about budgetary limitations?

Mr. BEGGS. Well, the President, I think, described the highlights of the program in his state of the Union address when he said that, first of all, he is directing a station development over the next 10 years for the early initial operating capability and that we were inviting broad international cooperation in the construction of that station, and, as well, we are inviting cooperation from the private sector, from industry, and commercial interests.

Senator ABDNOR. I realize that, but is that just a benefit primarily for the aerospace industry? What is it going to do for the country and the taxpayers and our deficit, for that matter? How much are we talking about?

Mr. BEGGS. We are talking about $8 billion in 1984 economics for the construction of that initial operating capability. We expect that once we have it up there, it will serve the country in a number of different ways. In the first place, it opens a lot of options for the future. It enables us to do the kinds of things we have been dreaming about doing ever since the beginning of this program. There have been space station plans in the NASA program since the beginning.

But it will serve as a staging base to allow us to move into higher orbits, and we expect, eventually, that there would be an orbital transfer vehicle, man-rated, associated with the station that would allow us to move readily into orbits all the way up to the geosynchronous and beyond. It will serve as a laboratory that will enable us to start doing the kind of experimentation in space that we have been trying to arrive at for some time. If you look back at November to the first flight of the Spacelab, the striking thing about that flight was the fact that we had 150-odd scientists on the ground working with the astronauts in space. As a consequence of that, they were able to repair the experiments that went wrong, they were able to modify experiments; and, indeed, when we queried the scientists at the mission, many of them said they accomplished more than 100 percent of their objective.

That, I think, is the key element of getting up there and being able to experiment in real time with human intelligence present; that is, you can take advantage of the often unexpected or chance results you get from experimentation.

We know from the history of scientific experimentation that oftimes the important results are not those that you have necessarily set as your objectives for the experiment, but the chance and unexpected results that have come along as you conduct the experiment.

If I could just add a couple other things, we expect that we will start to learn how to construct large structures in space and, perhaps, start to move in the direction of very large antennas and other structures that will enable us to do the kinds of things that we have been thinking about for many years in telecommunications.

The other things that we want the industry and the commercial interests to get in with us on is actual manufacturing in space. We have the first of those in the electrophoresis apparatus that McDonnell Douglas has been developing over years and that we have been flying, and we are very confident of that. We feel that we have a very significant commercial opportunity there, and that will be the first of, I believe, many, both of things that we manufacture in space and that we produce in space and then learn to duplicate on the ground.

If I can conclude this, Senator, by saying that I think what I meant was misleading a little bit. We are talking about $8 billion for the program over the next 8 years or so. Our request for 1985 is $150 million.

FISCAL YEAR 1985 REQUEST FOR SPACE STATION

Senator ABDNOR. What does that do for us?

Mr. BEGGS. That gets us started into the phase B work. It does a lot of work in the basic technologies that enable us to do the station. There is quite a lot of technology work we will need to pursue, and beyond that, we will go out to the industry with the phase B study probably early. Assuming this is approved, probably early next year.

Senator ABDNOR. The $8 billion gets you into all the advanced technology?

Mr. BEGGS. The $8 billion gets us to what we call initial operating capability, and that would enable us, we believe, to operate a station with a crew of six to eight human beings and to be in a position to start to do all of the things or start to work on the things I described.

Senator ABDNOR. Will this kind of technology never come about through other sources if the Government does not do it?

Mr. BEGGS. I think just as this program has pushed advanced technology in the past, I think this one will push it ahead faster in the future. The station will require a high degree of robotics and automation, and we will push hard against those technologies. I think they will advance more rapidly than they otherwise would. We will need a very substantial increase in telecommunications capability. We will have to do things such as partially closing the life support system to enable reuse of oxygen and water and perhaps other things.

It will also push into the various areas of being able to operate experiments in space. It will enable us to repair routinely in space, and I believe probably a lot of things that we haven't quite got our hands on yet as these programs do, as they move into the operational phase.

Senator ABDNOR. I guess I don't have anything more, other than to say that I am sure that there are a lot of long-range benefits. It is just a matter of where we find the dollars to do things. I guess its a matter of priorities.

BENEFITS RESULTING FROM SPACE R&D

Senator GARN. Let me just say in response to my colleague, when I first got to the Senate, there was still a separate Space Committee, an authorizing committee, and I served on that committee. As a matter of fact, my senior colleague, Senator Moss, was chairman of the Space Committee at that time. I can remember sitting there in those hearings when we promised NASA we would at least keep them whole for inflation in the budget. That promise has not been kept. That was a decade ago, and NASA's budgets have not kept pace even with inflation.

Where you look at the rest of the budgets in the Federal Government, you will find out just the opposite is true, most of them have not only kept pace with inflation, they have gone far beyond.

Also, Jim, I think you will find, if you look at some of the testimony over the years back in the authorizing committee as well as in the subcommittee, that is a fair question that you have asked, and it has been asked many, many times. I think the best answer I could give you about the Space Shuttle or the Space Station—is that the same question was asked about going to the Moon and then about the Space Shuttle. You can see the spinoffs of space programs in the civilian economy. Also in aeronautical research, what you are flying today in many commercial airliners came out of NASA, supercritical wings, more fuel-efficient engines, all sorts of developments that have been applied both civilian and militarywise; in communications; in navigation equipment; and, so many areas it is almost startling.

In fact, as much of a critic as I am of government, this is the only agency I know of that produces many, many more dollars in return for each dollar that is spent. My only regret is that we don't spend more, because the total NASA budget request for fiscal 1985 is a little over $7 billion, so when people ask me, "Why do we waste money in space when we ought to be spending on social programs." Food stamps alone are in excess of $12 billion. And I am not saying that we don't need some food stamps, but I do believe that is a program that is vastly abused, and there are a lot of people who are not going hungry who are on food stamps, but I think that is significant.

Just that one program alone is $5 billion more than the entire NASA budget for everything we do. I think we have short-changed the country, not NASA. I think we have short-changed the country, and one of the most important things we have in the whole battle with our adversaries is technology. We used to have such a vast technological leadership over the Soviet Union, and that is shrinking. Without NASA, I don't know where we would be.

So I realize, Jim, I have a bias; maybe, that comes from my own aviation background, but I think it can be proven in fact. What I have stated may eliminate my bias toward things that fly. I realize I have that, but I think it is a remarkable performance and that does not mean there have not been some wastes, inefficiencies, and Administrator Beggs will tell you I do not always agree with him, and we have some pretty good sessions over how the dollars are spent.

Let me only say in general terms I know of no Government agency that has returned so much back to the economy, with not even a close second. It isn't even like Avis and Hertz. No. 2 in the Government isn't even close.

Senator ABDNOR. Let me say, Mr. Chairman, you have given a very convincing statement.

Mr. BEGGS. Thank you. [Laughter.]

Senator ABDNOR. It is something to think about.

Thank you.

SHUTTLE-DERIVED LAUNCH VEHICLE

Senator GARN. I hate to do this. I can't imagine the Senate working so early in the morning. We usually wait until night before we start voting when we want to get home with our families, but we will have to recess the hearing. We do have a vote going, and I will go and vote and get back just as rapidly as I can.

Mr. BEGGS. Yes, sir.

[A brief recess was taken.]

Senator GARN. Your budget justification indicates that one of the activities that is being undertaken during fiscal year 1984 in your space transportation systems and advanced program is the development of Shuttle-derived launch vehicle concepts.

How much money do you intend to devote to this activity during fiscal year 1984 and how much is included in your fiscal year 1985 budget request for the development of these concepts?

Mr. BEGGS. $500,000 in 1984 and $5 million in 1985, Mr. Chairman.

Senator GARN. Could you describe the capability of the various vehicle configurations under consideration and the benefits associated with pursuing a Shuttle-derived expendable launch vehicle (ELV) versus existing or upgrades of existing ELV's?

Mr. BEGGS. Yes, sir. Initially, we understand the requirement is 10,000 pounds to synchronous orbit, and so the initial configuration would do just that; that is, the combination of the solid rocket boosters and the Centaur. We would use the standard Shuttle Centaur. We would be able to deliver over 10,000 pounds, but we are also looking beyond that to configurations that would go up to 20,000 pounds to geosynchronous orbit and configurations which could go up to the equivalent of a quarter of a million pounds or more in low Earth orbit.

All of those things look feasible. The advantage, of course, of using the Shuttle-derived or the solid rocket booster (SRB) based vehicles is that you can use the same launch facilities for the launch of them. You can use the same manufacturing facilities to manufacture the SRB's and, as a consequence, there ought to be a very substantial overall saving for the Nation with that.

If you use an ELV line of a different character, such as the Atlas or Titan, substantially upgraded, you would have to have separate launch facilities as well as a separate support force. So when you use the same facilities, the Shuttle support group and the same manufacturing train should save a significant sum of money.

NASA/DOD ELV COOPERATION

Senator GARN. You note in your budget justification that continued collaboration with DOD, which has identified similar needs, is planned. What specific input will NASA have in the DOD study now being conducted on ELV requirements?

Mr. BEGGS. We are trying to coordinate with DOD. We have had a number of meetings and we have gotten from them their requirements statement, and we will be meeting with them again several times during the coming 2 months. They are proceeding toward dates that provide for letting some kind of contract this summer.

ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE

Senator GARN. This year you are requesting $5 million for your Advanced Communications Technology Satellite (ACTS) program. How much did you include in your request to OMB for the ACTS program?

Mr. BEGGS. We had requested $92 million from the OMB, but that, of course, included the flight program; we have eliminated the flight program, but we are continuing the technology.

Senator GARN. What implication does that have in terms of the nature and scope of the program? What is it going to do designwise?

Mr. BEGGS. Designwise, we will go back to the tests on the ground. We will move, again, into the technology arena and develop the technology for the next step forward such as looking at the antenna, switching systems, the various modulation schemes, and so forth, and it will be a ground program including no flight experiments unless we fly from time to time to test out the components on the Shuttle.

HUGHES VERSUS NASA ACTS PROPOSAL

Senator GARN. What specific technologies are different between the Hughes proposal and the original NASA-recommended proposal?

Mr. BEGGS. It is really a difference in the nature of the technology they are employing. They are using current technology, obviously, but it is technology, to a large extent, that was developed by NASA or NASA in collaboration with the industry. They are using a standard antenna, but, of course, they are moving to the 30 to 20 gegahertz range. It will operate in the frequency range that has recently been opened up for this purpose and, of course, exploiting that is important for future commercial service because it allows broader bandwidths and other good things that increase capacity. But it is an antenna which has fixed beams instead of the scanning antenna that we were planning to fly. Our antenna was of a new type and we felt that the test of a scanning beam antenna was important because it looks like an important new development for the future.

The switching system they are using is based on current technology instead of a more advanced switching system that we have had under development in NASA. They will use frequency division multiple access up and time division multiple access down, and we were planning to use time division multiple access, which was the more sophisticated way of going at this, both up and down. There are differences in the way in which they do their signal regeneration on board and they will use a fixed margin for rain fade. What that means is, that at these higher frequencies, you do have interference, particularly in heavy rain. What NASA had planned to do was to use an adaptive control; that is, to sense what the problem was and to adapt to it in signal strength to try to improve the serviceability.

Having said all that, there are some major differences. We do feel that what Hughes flies, assuming they complete this program—and they do intend to invest, as I understand, $250 or $300 million in their program—will be a very modern piece of equipment, a very modern satellite. And from what we know about the Japanese work and the European work, it will be, in total, the equivalent of what the Japanese and Europeans are planning to fly. The reason we backed off from our flight experiment is because there was a commercial supplier who was moving out with a satellite to exploit the new part of the frequency spectrum.

U.S. TECHNOLOGICAL LEADERSHIP

Senator GARN. In your opening statement, you note that the ACTS program was originally designed to regain U.S. technological leadership in several important fields. Does this imply that the United States has lost its leadership or will soon lose that leadership?

Mr. BEGGS. No, sir; I don't believe so. I think the program we have by continuing to pursue the technology will hold our leadership. The question here was one of whether we ought to fly a flight experiment, whether we ought to demonstrate the technology in such a way as to give the industry confidence to go to the next step. Since we have a competent supplier who is willing to go the next step with the current level of technology, I think it behooves us to go back to the drawing board and the bench and to move off to the next level of technology so that when the next industry satellite goes up, it will use new generation equipment.

I think we can maintain our lead with that program, and there is no argument that we should continue to fund on the order of $20 million or so of that technology effort into the foreseeable future.

NUMERICAL AERODYNAMIC SIMULATION

Senator GARN. In fiscal year 1984, you requested $20 million for numerical aerodynamic simulation. This program represented a new start for NASA in fiscal year 1984. Congress provided $17 million. How much are you requesting in 1985?

Mr. BEGGS. $26.5 million is the ongoing R&D effort; the additional computers and software that we are buying. We are also requesting $16.5 million in the construction of facilities budget as a new start for a facility for those computers.

Senator GARN. What additional equipment do you intend to procure during fiscal year 1985?

Mr. Beggs. We plan to buy the high-speed processor that we started out to get initially—that is, the Cray-2—and we will also buy some work stations for the use of that computer as well as the software, a significant piece of the software in 1985.

Senator Garn. When will the Cray-2 be operational?

Mr. Beggs. We should achieve operational status in the spring of 1986.

Senator Garn. Has NASA developed a pricing policy for the use of the system once it is available?

Mr. Beggs. No, but we are working on formulating that pricing policy. Since there is a lot of interest in the use of this facility on the part of the Government and the industry, as well as the universities, we are going to have to come up with a pricing policy that will satisfy the needs of all those users. I expect we will go to the type of pricing that we have employed in the past, and that is to charge what, in essence, are the operational costs of using the system.

Senator Garn. When will you need to procure a second main frame computer for NASA?

Mr. Beggs. We think some time after the Cray-2 becomes operational in 1986. I expect we will have a request in the fiscal year 1986 budget cycle for a successor, if you will, or for a more capable computer than the Cray-2. In short, we want to keep stimulating the state of the art, to keep pushing the art, because we do need bigger and bigger number crunchers, if we are going to do the job we set out to do.

PRODUCTION OF SUPERCOMPUTERS

Senator Garn. When you originally requested funding for the NAS, you noted that one of the important reasons for proceeding with the project was that it would stimulate the production of advanced U.S. supercomputers. In a recent March 9, 1984, memorandum to the subcommittee, you noted, however, that NASA intends to select the most powerful high-speed processor no matter what the country of origin.

How do you reconcile the two statements, and what is your policy vis-a-vis the purchase of foreign supercomputers for NASA?

Mr. Beggs. I will admit that on the surface, it would sound that those statements are not in concert, but I think they are. We do believe that the computer we are buying is the most advanced computer we can find; that is, the Cray, which is a U.S. supplier. We think that the U.S. computer industry is responding vigorously. We have two suppliers that are working very hard on advanced computers. They are the Cray and the CDC companies.

We are keeping, though, in our policy position that we will look at foreign developed computers as they become available. We think that the fact that we are willing to look out there should further stimulate the U.S. industry to continue to stay ahead, and we do believe they still are ahead.

Do you want to say anything more about that?

Dr. Mark. I think you have said it all. I think there is one issue here that I would like to get on the record, and that is a question with respect to the relative state of the Japanese competence in supercomputers and the competence that this country has. There has been a lot of talk about that. I think it is important to understand where we really are.

The Japanese have made excellent strides in the development of components; that is, they have a very good component industry. They make very, very good semiconductors, very good chips, and they are, in some cases, in the component business. In fact, they are ahead of the United States as far as being able to manufacture reliable and advanced components.

On the other hand, in the matter of architecture—that is, how you put these components together to actually solve a problem—in my judgment, they are way behind. They have built computers that have met what we call benchmark tests successfully that are comparable to our fastest machines. They are still behind the United States in operational systems. I think that is where the game is, in the question of architecture and the question of software for operating systems.

CLOSURE OF TDRSS GROUND STATIONS

Senator Garn. In describing your tracking and data acquisition program for fiscal year 1985, you note that once TDRSS becomes operational, a number of ground stations will be closed. Would you provide for the record a list of the ground stations you expect will be closed, the expected annual savings, and the effect on NASA FTE and the schedule dates for these closings?

Mr. Beggs. Yes, sir.

[The information follows:]

We expected to close the following ground stations with the advent of TDRSS operational service: Ascension Island; Garborone, Botswana; Dakar, Senegal; Santiago, Chile; Guam; and Hawaii and terminate VHR air-to-ground voice capability at Yarragadee, Australia. If the TDRS-C launch occurs in July 1985, we would anticipate cessation of operations at these stations around October 1, 1985. If the TDRS-C launch is delayed, our closure actions would also be delayed.

Through these closures, we expect to achieve an annual savings in the spaceflight tracking data network (STDN) of approximately $45 million (expressed in fiscal year 1985 dollars). Approximately 540 NASA full-time equivalent employment will be reduced when these stations are deactivated.

TDRSS CAP

Senator Garn. In fiscal year 1983, Congress established a cap of $2.704 billion for the TDRSS. Is your current operating plan designed to limit the total program costs to no more than the current cap?

Mr. Beggs. The current operating plan is based on a program which would, I think, exceed that cap, Mr. Chairman. The increases are largely as a result of the troubles we have had in the last year. You are very familiar with the problem we had in the initial launch, and I think the committee is familiar with the problem we continue to have with the inertial upper stage (IUS).

We have had discussions with the Air Force recently on the IUS problem, but we still do not have a firm date when the IUS will be available to us. All of those things—although I should add in there we expect that we will be able to start flying the TDRSS again early next year—but all of those have had the latest in added costs, so that the program plan we are on now, if continued through the 10-year period that should be added, will result in program costs in excess of that $2.704 billion cap that we have.

SUBMITTED QUESTIONS

Senator GARN. Mr. Beggs, I have got some good news and some bad news for you. The good news is that due to the interruption of the vote, I am going to stay on schedule and not ask you orally some of the questions I have. The bad news is I have 116 pages of questions for you to respond to for the record.

Mr. BEGGS. Oh, dear.

Senator GARN. We do appreciate your willingness to be here today, all of you, and thank you very much for the good job that you do.

Mr. BEGGS. Thank you, sir.

Senator GARN. Now we will transition to OTA.

[The following questions were not asked at the hearing but were submitted for response for the record:]

QUESTIONS SUBMITTED BY SENATOR GARN

Priorities for Budget Changes

Question: If the Congress were to reduce your FY 1983 Research and Development (R&D) account by $20 million, how would you allocate this reduction--be specific?

Answer: A reduction of $20 million below the President's budget request in R&D in FY 1985 would probably be absorbed by deferring activities such as logistics and follow-on hardware in the operation capability development area, reducing the initial increment of funding on new flight initiatives such as the Upper Atmospheric Research Satellite (UARS) and holding Space Technology supporting research closer to existing levels.

Question: Please prepare additional lists for reductions of $30 million, $40 million and $50 million.

Answer: A reduction of $30 million in R&D probably extend the adjustments to current flight projects, such as Gamma Ray Observatory (GRO) and Tethered Satellite; a $40 million cut would involve deeper reduction in supporting technology including Aeronautics and a $50 million reduction could lead to a significant rephasing of new science initiatives.

Question: If the Congress were to reduce your Space Flight, Control and Data Communications account by $20 million, $30 million, $40 million or $50 million, how would you allocate these reductions?

Answer: Reduction in Space Flight, Control and Data Communications handling of $20-$50 million would probably be absorbed by a combination of shifts in the STS manifest that may result in upper stage development delays and a reduction in the amounts provided for Shuttle subsystem modifications.

Question: If the Congress were to reduce your FY 1983 Research and Program Management (R&PM) account by $5 million, $10 million, $15 million or $20 million, how would you allocate these reductions--provide a breakdown by object class?

Answer: If reductions to the R&PM request were imposed as stated, NASA would attempt to accomplish the required reductions to program operations in such a manner as to minimize the detrimental effects, especially on its civil services workforce. The exact degree that any of the following actions will be taken, if a reduction of $20.0 million is imposed, is dependent on the actual FY 1984 pay raise supplemental appropriated and the degree that actual price increases in FY 1985 may exceed the amount we have estimated for them in our budget request.

Specifically, in the area of Personnel and Related Costs, we would have to curtail our training and temporary personnel programs, to lengthen the interval between the time a person leaves and when a replacement arrives, and to adversely modify our science and engineering freshout hiring program. The amount of travel NASA employees will take as part of management review of programs and contracts will be reduced, as well as the number of support service contractor man years NASA will be able to purchase. Purchases of supplies, materials and equipment planned for FY 1985 will have to be deferred into FY 1986. Finally, the necessary operational maintenance augmentation activities planned for FY 1985 would have to be curtailed.

Question: If the Congress were to reduce your Construction of Facilities (CofF) account by $10 million, $15 million, or $20 million, how would you allocate these reductions?

Answer: The request for Construction of Facilities funding is the result of a continuing negotiation process over many months between and among the NASA Centers, Program Offices, the Administrator, and the OMB. If a significant reduction in the CofF proposed funding were to be made, the negotiation process within NASA would again be undertaken to realign the projects with the objective of postponing those projects that would be more adaptable to a short-term delay.

Question: If the Congress were to increase your R&D account by $20 million, $30 million, $50 million or $70 million, where would you apply these increases? If the Congress were to increase your Space Flight, Control and Data Communications account by $20 million, $30 million, $40 million or $50 million, where would you apply these increases? If the Congress were to increase your CofF account by $10 million, $15 million or $20 million, where would you apply these increases?

Answer: The FY 1985 budget, as requested of Congress, contains a carefully balanced program within the President's recommendation for the total Federal budget. Although many areas have been considered in which additional funding could be productively applied, NASA cannot recommend any specific increases in the budget as requested.

Outyear Projections

Question: Your opening statement implies that you have negotiated an agreement with OMB that NASA's future budget will incorporate, not only the cost of current programs, but will include an allowance for future new initiatives.

Could you please provide the aggregate increases that this agreement contains, above and beyond the Space Station program, for FY 1986 through FY 1990?

Answer: The NASA's FY 1985 budget provides for an increase of one percent per year over and above inflation, as projected in the President's FY 1985 Budget; which is above the cost of current programs including the Space Station.

Question: You indicate that an agreement to include future projects differs from previous practice.

Does this differ from the previous agreement that NASA and OMB developed relative to the Space Shuttle?

Do the amounts included for future new initiatives include the base amount recommended by the Solar System Exploration Committee of around $350 million each year?

Answer: The primary difference, between the current agreement and the previous agreement, is that NASA is currently allowed real growth of one percent per year. The agreement relative to the Space Shuttle did not provide for an increase in the budget level.

The Solar System Exploration Committee (SSEC) recommended a level of about $300 million per year (FY 1984 dollars) for total Planetary Explorations activities; the real growth of 1 percent per year will support this recommendation.

Research and Development Outlays

Question: During FY 1984, you estimate your outlays for the Research and Development account to be $2,603,600,000. In FY 1985, you estimate the outlays for this account to be $2,375,000,000.

How do you account for this decrease of $228.6 million?

What are the specific components that account for this decrease?

Answer: The outlays shown for Research and Development include the spend out of funds appropriated in prior years. Since the Space Shuttle was included in the R&D appropriation in FY 1983 (prior to the establishment of the Space Flight, Control and Data Communications Appropriation), this diminishing prior year availability results in a larger total outlay in FY 1984 than in FY 1985.

Extraneous Tables

Question: In several places in your justification, e.g., Page RD Sum-7 and SF Sum-7, you have included a table which distributes the funds in each of your accounts among the various budget functions. In the future, please delete these tables from your budget justifications.

Answer: As requested, the table will be deleted from our justifications.

Research and Development Bill Language

Question: Could you please correct the Research and Development bill language contained on Page RD Sum-3 of your budget justification to indicate those "caps" which you would like deleted from the FY 1985 language?

Could you please also update those caps so that they are consistent with your FY 1985 request?

Answer: For necessary expenses, not otherwise provided for, including research, development, operations, services, minor construction, maintenance, repair, rehabilitation and modification of real and personal property; purchase, hire, maintenance, and operation of other than administrative aircraft, necessary for the conduct and support of aeronautical and space research and development activities of the National Aeronautics and Space Administration, $2,400,100,000 to remain available until September 30, 1986. (42 U.S.C. 2451, et. seq.; Department of Housing and Urban Development - Independent Agencies Appropriation Act, 1984.)

For necessary expenses, not otherwise provided for, including research, development, operations, services, minor construction, maintenance, repair, rehabilitation and modification of real and personal property; purchase, hire, maintenance, and operation of other than administrative aircraft, necessary for the conduct and support of aeronautical and space research and development activities of the National Aeronautics and Space Administration; including not to exceed (1)

$361,400,000 for space transportation capability development; (2) $150,000,000 for a Space Station; (3) $195,000,000 for Space Telescope development; (4) $26,500,000 for Numerical Aerodynamic Simulation; without the approval of the Committees on Appropriations $2,400,100,000 to remain available until September 30, 1986. (42 U.S.C. 2451, et. seq.; Department of Housing and Urban Development - Independent Agencies Appropriation Act, 1984.)

Distribution of Space Station Funding

Question: Could you please provide, for the record, a distribution among your installations of the $150 million requested in your FY 1985 budget for the Space Station program?

Answer: A final disposition of the distribution of the $150 million by field installation will not be made until after the field center roles and missions decision is made and after the completion of our internal budgeting process (the program operating plan).

Monitoring of Contractors

Question: Last year, I stated that we would like to include a listing of your staffing needs each time a new program start is initiated.

Could you please provide that information for the record?

Have you determined what the required staffing levels should be to monitor the contractors?

Answer: The FY 1985 justification books contain the requested information. For Upper Atmospheric Research Satellite (UARS) and Mars Geoscience Climatology Orbiter (MGCO), the FY 1985 staffing and estimated totals are:

	Direct Workyears	
	FY 1985	Total for Life of Project
UARS (Civil Service)	90-100	560-570
MGCO (JPL only)	48	487

For the Space Station, only a preliminary FY 1985 estimate is available and is as follows by Center:

	1985 Direct Workyears
Johnson Space Center	200
Kennedy Space Center	100
Marshall Space Flight Center	150
Goddard Space Flight Center	50
Ames Research Center	25
Langley Research Center	25
Lewis Research Center	25
Headquarters	25
	600

The full staffing of the Space Station, including that required to monitor contractor effort, is under study. As full Center assignments are made and the definition work progresses, these amounts may change. We believe that assigned levels of direct civil service workyears are adequate to carry out the program as planned.

Private Sector Services

Question: How much money did NASA receive for services provided to the private sector in FY 1983?

How much is estimated for FY 1984 and FY 1985?

Answer: NASA received $282 million from non- U.S. Government entities for provided services in FY 1983. The receipts are distributed as follows:

	($ in millions)
Private sector	225
Foreign	57
TOTAL	282

Based upon current estimates, NASA expects to receive approximately $284 million in FY 1984 and $366 million in FY 1985. The distribution of estimated receipts are:

	($ in millions)	
	FY 1984	FY 1985
Private sector	229	272
Foreign	55	93
TOTAL	284	365

Question: Could you please provide, for the record, a detail of these amounts by services rendered?

Answer: During FY 1983, NASA received $282 million from non-U.S. Government sources.

Senator Garn—Continued

Approximately, $269 million was received in support of the Space Transportation System program. Received funds supported activities such as:

	($ in millions)
o Upper stage operations	14.1
o Payload support operations	11.3
o Space Shuttle operations	91.6
o Expendable launch vehicles	150.1
o Spacelab/Spacelab operations	1.5
o Miscellaneous	.4

The remaining $13 million was received to support the following:

- Physics and astronomy activities such as the balloon program, solar polar mission development, sounding rockets, and the explorer program - $1.4 million
- Space applications activities such as applications systems analysis and studies, advanced communications research, Landsat-D ground stations and stratospheric air quality - $6.0 million
- Energy activities such as solar energy systems, conservation of fossil fuel, and many limited funded ($250 thousand or less) activities - $3.2 million
- Tracking and data activities such as network operation - $2.1 million
- Miscellaneous activities $.3 million

FY 1984 and 1985 estimated receipts are projected to be received as follows:

	($ in thousands)	
	FY 1984	FY 1985
STS Programs		
Spacelab	7,000	7,000
Research & test operations	3,200	1,800
Payload support operations	10,300	10,600
Space Shuttle operations	255,800	341,900
Physics and Astronomy		
Balloon program	59	59
Astrophysics mission operations	81	80
Sounding rockets	41	--
Planetary Exploration		
Mission operations	30	--

Senator Garn—Continued

Space Applications		
Applications systems analysis and studies	1,176	637
Advanced communications and research	1,100	--
Landsat-D	1,100	--
Technology Utilization		
Civil Systems	430	375
Energy	1,100	800
Tracking and Data Network Operations	2,849	2,263

Johnson Space Center Funding

Question: Your budget justification shows the FY 1983 funding of the Johnson Space Center at $1,745,163,000. In FY 1984, you estimate the funding level at $1,613,373,000. Your FY 1985 estimate is for $1,437,916,000.

Please describe the programmatic changes that are expected to result in the $175,457,000 decrease from the FY 1984 level.

Answer: The projected decrease of $175.5 million between FY 1984 and FY 1985 at the Johnson Space Center is primarily related to changes in funding for the Shuttle Production and Capability Development activity and the direct funding for Shuttle Operations. Shuttle Production and Capability Development decreases is largely attributable to the planned delivery of the fourth orbiter during December, 1984. This orbiter is the final production orbiter in the currently approved program. Shuttle operations direct funding is projected to decrease by $43 million. This decrease is offset by an increase in anticipated reimbursements for Shuttle flights and the overall level of activity in operations (direct plus reimbursable) is actually projected to increase by $60 million.

Question: How much of the $150 million for the Space Station will be assigned to Johnson Space Center?

Answer: A final disposition of the distribution of the $150 million by field installation will be made until after the field center roles and missions decision is made and after the completion of our internal budgeting process (the program operating plan).

SES Bonuses

Question: How much have you included in your budget for SES bonuses during FY 1985?

Answer: The FY 1985 budget request includes $875,000 for SES bonuses.

Administrative Changes

Question: In your opening statement, you make note of an Agency-wide productivity improvement and quality enhancement program. This program has resulted in recommendations for streamlining your administrative process.

Can you describe the recommendations resulting from that program and what do you intend to do to implement them?

Answer: The recommendations for streamlining NASA's administrative process span a broad range of activities which include shortening lead-time and reducing unnecessary paperwork. An Acquisition Lead-time Committee composed of representatives from Headquarters and field installations made a thorough study of the procurement administrative processes, and submitted a report containing many recommendations. The Administrator approved the report and the accompanying action plan and will receive a progress report of the implementation this spring. For paperwork reduction, an Agency Task Force has completed one half of the process of reviewing with program and technical offices and is expecting an overall 20 percent reduction. A final report of this paperwork reduction activity is due this summer. Our streamlining processes will involve, as one can expect, changes of attitude, and we have tried to encourage this in a recently issued Administrator's policy statement on increasing productivity by delegating responsibility to the lowest possible level.

NASA Permanent Positions

Question: Page AS-14 of your budget justification contains a table listing the total number of permanent positions by NASA installation. That table shows that for each of your nine installations, the permanent position levels are the same in FY 1985 as in FY 1984. How do you account for the fact that while your program mix, including the proposed new start on a Space Station, since FY 1984 has changed considerably, your permanent positions by installation remain unchanged?

Answer: The workyear values shown in the referenced table reflect the planned continuing needs of the Agency. Since the permanent civil service workforce makes up only about 15 percent of the total effort applied to NASA programs, it should be recognized that most major changes in both levels of effort and skill mix requirements will be accommodated within the workforce of the private sector supporting NASA programs. The levels shown for the NASA installations for FY 1984 and FY 1985 depict the firm estimates of the effort required to carryout the in-house R&D work and to provide effective and efficient management of the contractual effort related to NASA programs. While no major changes in the workyear levels by center are currently anticipated for FY 1984 or FY 1985, some small adjustments may be necessary and these will be accomplished as such decisions are made.

Question: I understand that your are considering reducing the number of permanent workyears in Headquarters. When would such a reduction occur and how many workyears are involved. Would these workyears be redistributed among the various NASA Centers and how many would each center receive?

Answer: I have asked a study group to recommend to me functions which could be eliminated or reduced at Headquarters and any associated manpower savings which could be made. The purpose would be to make more workyears available to support our programs at the centers.

I am reviewing the study group's recommendations. Until I complete my review, I cannot identify the timing or size of any reductions or the nature of the redistribution of workyears.

Question: Please present your OMB request for permanent positions for each of these installations.

Answer: The request follows:

	Civil Service Workyears FY 1985	
	OMB	Congressional
Johnson Space Center	3,209	3,209
Kennedy Space Center	2,082	2,082
Marshall Space Flight Center	3,291	3,250
National Space Technology Laboratories	109	107
Goddard Space Flight Center	3,620	3,599
Ames Research Center	2,048	2,021
Langley Research Center	2,860	2,835

Senator Garn—Continued

Lewis Research Center	2,627	2,591
Headquarters	1,423	1,423
Subtotal Full Time Permanent	21,269	21,117
Other than full-time permanent	931	883
TOTAL	22,200	22,000

Research and Program Management Augmentation

Question: Your FY 1985 Research and Program Management request includes an increase of $10 million to augment recurring operational and preventive maintenance activities.

Would you please describe the specific activities and programs that will be augmented and the rationale for recommending these increases?

Answer: The purpose of the augmentation is to increase operational or preventive maintenance activities to a more reasonable level in order to reduce the number of emergency or "fix it because its broken" situations, which have been increasing in recent years. Emergency repairs are more expensive to make in terms of lost productive time of our research and development personnel and in the efficient scheduling of maintenance personnel. The $10 million augmentation will be used to increase the number of support service contract effort in the R&PM funded maintenance function by about 170 workyears, and to cover the attendant minor contracts, supplies and materials.

Overall, the level of maintenance will be increased. Examples of specific activities in this area are:

1. Increase the effort in the pressure vessel recertification effort to assure safe operation of NASA's high pressure systems. Because of the lack of resources in this area, some systems have been down-rated to lower-than-designed pressure operations. This increase in inspection will help restore operation of these systems to their full pressure levels.

2. Updating of the fire alarm systems in the administrative buildings at Ames Research Center (ARC). This will include installation of more modern components and the performance of regular maintenance on the system. Encapsulation of asbestos ceiling tiles at Dryden Flight Research

Facility modification of the library building for earthquake integrity will also be done.

3. At the Kennedy Space Center, additional effort will be expended to place the air conditioning chillers in the Operations and Checkout Building and the Flight Crew Support Facility on a scheduled maintenance program. This program will include recommended periodic inspections and maintenance on these vital pieces of support equipment.

4. At the Lewis Research Center, an increase in the frequency of corrosion control inspections and repairs of the 40-year old water, sewer and natural gas lines.

5. At the Marshall Space Flight Center and Goddard Space Flight Center, include inspection, maintenance and repair of safety related items, boilers, steamlines, electrical systems, roofs, roads, buildings and seawalls (at Wallops Flight Facility).

Travel

Question: This year you are requesting $28 million for Agency travel. This represents an increase of $2.3 million over your FY 1984 level.

Could you please prepare, for the record, a travel budget for FY 1984 and FY 1985 for each of the offices and installations?

Answer: The requested material follows:

NASA Travel Budget
($ in thousands)

Installation	FY 1984	FY 1985
Johnson Space Center	4,448	4,971
Kennedy Space Center	2,256	2,688
Marshall Space Flight Center	4,001	4,211
National Space Technology Laboratories	170	170
Goddard Space Flight Center	3,676	3,935
Ames Research Center	2,391	2,493
Langley Research Center	2,294	2,525
Lewis Research Center	1,979	2,178
Headquarters	4,485	4,829
Office of Space Flight	(1,018)	(1,096)
Office of Aeronautics and Space Technology	(712)	(767)

Office of Space Tracking and Data Acquisition	(541)	(582)
Office of Management	(344)	(370)
Office of External Affairs	(418)	(450)
Office of Inspector General	(212)	(228)
Office of the Comptroller	(137)	(147)
Other	(935)	(1,008)
TOTAL NASA	25,700	28,000

Operation of Installation

Question: Your FY 1984 operating plan assumes the need for $319,854,000 for the operation of your installations. Your FY 1985 budget projects a need for $367,072,000 for this purpose. This represents a 14.8 percent increase over the FY 1984 level. Ten million dollars of that increase is associated with the augmentation of your operational maintenance. Why do you believe that such an augmentation as now required?

What specific maintenance activities would receive major emphasis?

How would this additional $10 million be allocated across your installations?

Answer: As noted above, this augmentation will increase operational or preventive maintenance to a more reasonable level. The distribution of the $10 million by Center is as follows:

	FY 1985 Increase ($ in millions)
Johnson Space Center	.8
Kennedy Space Center	.8
Marshall Space Flight Center	1.7
National Space Technology Laboratories	.4
Goddard Space Flight Center	1.2
Ames Research Center	1.7
Langley Research Center	1.7
Lewis Research Center	1.7

Construction of Facilities

Question: In FY 1984, you are requesting $160 million for your Construction of Facilities program. This represents an increase of $4.5 million above the FY 1983 appropriated level.

Please provide, for the record, a listing of the specific projects included in your FY 1984 budget request, including the original request to OMB for each of these projects and the amount included in the budget.

Answer: The requested listing follows:

Loc.	Project Title	($ in millions) To OMB	 To Congress
MSFC	Repairs to Test Stand 500	1.6	1.6
JSC	Modification of Site Electrical Substation	3.2	3.2
NSTL	Modifications for Single Engine Testing	3.0	3.0
KSC	Construction of Launch Complex 39 Logistics Facility	10.0	10.0
KSC	Construction of Solid Rocket Booster Assembly and Refurbishment Facility	15.0	15.0
KSC	Construction of Additions to the Cargo Hazardous Servicing Facility	5.0	4.6
ARC	Construction of Biomedical Research Facility	2.1	2.1
GSFC	Construction of Addition to the Network Control Center	2.2	2.2
JPL	Construction of Earth and Space Science Laboratory	12.4	12.2
ARC	Construction of Numerical Aerodynamic Simulation Facility	17.1	16.5
LaRC	Modifications to 8-Foot High Temperature Tunnel	14.1	13.8
VAR	Construction of 34-Meter Antenna, Madrid, Spain	6.2	6.0
VAR	Modifications of 64-Meter Antenna, DSS-63, Madrid, Spain	8.0	7.8

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VAR	Repair of Facilities at Various Locations	20.0	20.0
VAR	Rehabilitation and Modification of Facilities at Various Locations	25.0	25.0
VAR	Minor Construction of New Facilities and Additions to Existing Facilities at Various Locations	5.0	5.0
VAR	Facility Planning and Design	12.0	12.0
	TOTAL	161.9	160.0

Question: Please prepare a list showing each of the items not included in the FY 1985 request that were, however, included in your original submission to OMB, include the amounts you requested for each of these items.

Answer: The requested listing follows:

Loc.	Project Title	Requested ($ in millions)
KSC	Installation of Cabling from VABR to Pad B	.7
KSC	Construction of Payload Control Rooms	1.2
KSC	Modifications for Horizontal Payload Observations	2.1
KSC	Construction of Addition to Hangar AM	.4
KSC	Construction of Addition to Orbiter Processing Facility Annex	2.7
GSFC	Construction of Spacecraft/Payload Integration and Refurbishment Facility	15.0
LaRC	Modifications to 16-Foot Transonic Tunnel	4.7
LeRC	Construction of Antenna Technology Laboratory	6.8
MSFC	Modification to Test Position 115 for High Pressure Cryogenic Testing	1.8

Question: Please provide a list of those CofF projects that are related to Shuttle operations, include the original request to OMB and the amount contained in your FY 1985 budget.

Answer: The requested listing follows:

Loc.	Project Title	OMB	Amount
		($ in millions)	
KSC	Construction of Additions to Cargo Hazardous Servicing Facility	5.0	4.6
JSC	Modification of Site Electrical Substation	3.2	3.2
NSTL	Modifications for Single Engine Testing	3.0	3.0
KSC	Construction of Launch Complex 39 Logistics Facility	10.0	10.0
KSC	Construction of Solid Rocket Booster Assembly and Refurbishment Facility	15.0	15.0

Question: Please indicate those items in the above list that are related to maintaining or increasing the flight rate of the Shuttle.

Answer: All items in the above list are related to maintaining or increasing the flight rate of the Shuttle.

Construction of Facilities - (JPL)

Question: I understand that you are considering the construction of a new facility at the Jet Propulsion Laboratory (JPL). How much would you expect this facility to cost?

Answer: The expected cost of this facility is:

Construction Costs	$17,000,000
NASA Payments (P&I) over 12 years	$27,639,000
Total Building costs over 12 years (Including related JPL project costs)	$30,522,000

Question: If the Government were to enter into an agreement with Caltech to lease this building and thereby amortize the construction costs, what would be the total payments made by the Government?

Have you done a cost/benefit analysis of the various financing options?

Answer: The contract with Caltech would be modified to provide this facility as opposed to a separate lease back agreement.

The total payments made by the Government would be $30,522,000 over a ten year occupancy period with a Net Present Value of $15,609,000.

Yes, comparative cost/benefit analyses have been made for a Caltech--financed building and a Government-funded CofF project for the same building. The GAO standard methodology and the OMB specified methodology for cost/benefit analyses were utilized for comparison purposes. All of the analyses clearly show that either approach represents a sound investment for the Government. The break-even point occurs in 1995 for the Caltech--financed building and in 1998 for the CofF building using Net Present Values.

Over a 40-year occupancy period the comparative analyses show a net present value advantage of $1.7 million for the Caltech--financed building using the GAO methodology and a $3.6 million advantage using the OMB method.

Question: Would you recommend funding this facility out of the requested $160 million for Construction of Facilities?

Answer: The facility could not be accommodated within the NASA FY 1985 budget request due to other priority requirements, but it should be recognized that such a facility financed by Caltech and repaid over a ten year period of occupancy is a sound investment for the Government. This option is far more cost effective then continuing to lease buildings in the Pasadena area and to continue the use of inadequate trailers on the laboratory site. The cost/benefit analyses reflect over $4.7 million in savings during the first ten years of occupancy. This option provides a cost effective and viable means for helping eliminate a critical shortage of laboratory and office space at Jet Propulsion Laboratory.

Construction of Facilities - KSC

Question: During FY 1984, the Congress added $20 million to your Construction of Facilities budget to being work on a Solid Rocket Booster Assembly and Refurbishment Facility, and also a logistics facility at the Cape. How much are you requesting for the completion of these two facilities in FY 1985?

Answer: Our FY 1985 request includes $15 million to complete the "Construction of Solid Rocket Booster Assembly and Refurbishment Facility" and $10 million to complete the "Construction of Launch Complex 39 Logistics Facility."

Question: Could you please describe the status of these two facilities at the present time and their expected completion and occupancy dates?

Answer: The construction of the site preparation work using $3.45 million of reprogrammed FY 1983 resources underway and is scheduled to be completed in September, 1984.

The design for the SRB Assembly and Refurbishment Facility will be accomplished as a part of the recompeted SRB Refurbishment Contract. Proposals for the recompetition of this contract were received on March 15, 1984, and are being evaluated by a selection evaluation board. Under the terms of the procurement, the proposals include a 60 percent final design package for the facility. The SRB Refurbishment Contractor is scheduled to be selected in July, 1984. The design of the facility will then be completed by the successful contractor with construction scheduled to start in the fall of 1984 and be completed and operational by April, 1986.

The design of the Launch Complex 39 Logistics Facility is scheduled to be completed by October, 1984. To accelerate the construction, a site work phase is scheduled for contract award in August, 1984, with the building phase scheduled to start in October, 1984. All construction is planned to be completed by August, 1985, to meet an operational readiness date of October, 1985.

Pad B at Kennedy Space Center

Question: Could you please describe the status of the work on Pad B at the Kennedy Space Center (KSC) and indicate the remaining activities that need to be done before the operational date of January 1, 1986?

Answer: The construction work for Launch Complex 39 Pad B, totaling approximately $50 million, is 95 percent complete. The remaining items include the installation of a 90-ton hoist, high-intensity lighting, automatic washdown system and electric power system modifications. This work will be completed by December, 1984. In addition to the construction work, there are other R&D funded activation activities which include equipment procurement, installation and modification, checkout and activation. All of this R&D funded work is proceeding on schedule to meet the January 1, 1986, operational readiness date.

Space Commercialization

Question: Could you describe the roles of the various agencies (DOD, DOT, NASA, NOAA, etc.) in space commercialization?

Answer: NASA has initiated several activities which support the national objective in space. NASA has also been conducting an internal review of the commercialization of space with a Commercialization Task Force. One of the functions of this Task Force is to recommend a NASA role in the commercialization of space. The DOT is presently the only agency with a defined role in the commercialization of space. This role is related to the operation of Expendable Launch Vehicles by the private sector.

Question: What interagency mechanism has been established and what are their specific purposes?

Answer: At present, there are no interagency mechanisms related to the commercialization of space.

Space Station and Other Options

Question: In your opening statement, you note that, "the Station is, I believe, the next logical step in space". This statement implies that other options, in addition to the Space Station, were considered. What were these options and why were they rejected in favor of a manned Space Station?

Answer: Two options were considered. The first was to proceed with improvements to the Space Transportation System, developing concurrently an unmanned platform for the conduct of science. The second option was to commit immediately to a large, fully capable manned Space Station. The first option was considered to be too limited a step in improving U.S. space capabilities. It would not support the commercial utilization of space nor would it ensure a position of leadership during the 1990's. The second option was considered to be unnecessarily costly. The option chosen, a permanently manned, evolutionary Space Station to be operational in the early 1990's will secure--at an affordable level of funding--the space leadership so essential to our national well-being and will fully support both space science and commercial ventures in space.

Space Station Funding Summary

Question: What was your request to OMB in FY 1985 for non-generic technology related Space Station funding?

Answer: NASA requested $40.0 million for non-generic technology related to Space Station.

Question: What specific programs and activities could not be undertaken at the $150 million level that would have been performed given the approval of your request to OMB?

Answer: The NASA FY 1985 request to the OMB was for the initiation of an extended definition effort totaling approximately $700 million (real year dollars). Despite the reduction in FY 1985, we are still planning to allocate $700 million on definition through FY 1987 by rephasing the funding over that three year period. The major impact of the reduction in FY 1985 will be a four-month delay in the start of Phase B contract definition studies and a subsequent delay in the initiation of the development contracts. Since this rephased definition funding is not a reduction of our overall three-year request, our planning remains essentially unchanged.

Question: Please present a detailed breakdown of the $8 billion Space Station costs for each of the deliverable elements (e.g., solar arrays, berthing module, habitat, etc.) including R&D costs.

Answer: The costs for the initial Space Station have been summarized by function rather than by element (see enclosure 1). However, as we proceed with the Phase B contracts, detailed element costs will become available.

Question: What criteria for foreign investment in the Space Station would be used to determine if such investment should be considered as an off-set to the above costs or as an add-on to the total Station costs?

Answer: Foreign participation will be in addition to the estimated $8 billion U.S. program since the President has committed the United States to providing a permanently manned Space Station within a decade-independent of whether our friends and allies accept his invitation to participate in the program.

Space Station Cost

Question: In describing the expected cost of the Space Station, you indicate that the "enabling capability" of the Space Station can be in place within a decade and for approximately $8 billion in today's dollars. What is your exact definition of enabling capability--that is, what specifically will we buy for this $8 billion?

Answer: The $8 billion estimate has been categorized by the following functions: definition studies, laboratory, habitat, resources, multiple berthing, logistics, servicing, platforms, and support services. The exact degree of capability for each of these functions will be determined during the definition phase keeping in mind the user requirements and the technology that will be available for the baseline Space Station.

Foreign Participation in the Space Station Program

Question: In March, you traveled to Europe, Japan, and Canada to discuss the possibility of foreign involvement in the Space Station program. You note in your justification that such involvement should be "meaningful". What specific activities associated with the Space Station program would you consider to be of sufficient importance to be classified as "meaningful".

Answer: In order for foreign contributions to a U.S. Space Station program to be meaningful, they should contribute significant capability to the Station. They also represent a significant financial commitment by the contributing partner. While a broad range of possible foreign cooperative activities exists, specific criteria have not yet been established. Foreign proposals for participation are expected later this year.

Question: What conditions of participation were raised by these Governments?

Answer: The purpose of these initial visits was not to discuss specific conditions of participation, but rather to broadly invite participation and open discussions which will lead to discussions of specific conditions.

Question: What concerns were discussed--did the potential presence of DOD missions on the Space Station raise any concerns on the part of these Governments?

Answer: Principal concern raised by our foreign partners was the question of U.S. commitment to the continuity of the program. In each country, the issue of potential involvement in a civilian Space Station program by the Department of Defense was raised.

Question: What level of involvement and commitment, if any, were these Governments willing to discuss or to make?

Answer: These were initial discussions and the level of involvement and commitment is a matter for future negotiation.

Space Station Advance Technology

Question: Your opening statement notes that NASA will incorporate the "most advanced technology available" in the Space Station design.

How are you defining the term "available"--does this imply that you intend to "freeze" the technology at its current level?

If not, what specific automation, robotics, and information processing technology advancements have you targeted for the Space Station program?

Answer: Both NASA and industry have concluded that the current state of technology in specific disciplines is inadequate to permit building the desired Space Station without compromising capability and/or adversely impacting operational cost. The proposed Space Station hardware start date in FY 1987 allows several years in which new or advanced technologies can mature. therefore, a major thrust of the Space Station program is to accelerate the development of high-leverage technologies to enable the desired system. These technologies are not available today in the sense that they are not sufficiently mature to be baselined into the system design. The "freezing" of technology for the initial Space Station will occur in FY 1987. NASA's technology development activities will cut across a broad front of technical subsystem disciplines such as data management, thermal, power, life support, propulsion, and others. A fundamental criteria for these activities is to apply automation technology and techniques across-the-board recognizing that the desired Space Station is one which is highly automated in its internal housekeeping/ operational functions. This objective is desired to optimize man's time for highly productive, on-orbit activities.

Space Station Automation

Question: On February 24, NASA and the Subcommittee reached an agreement on the nature of a Space Station automation study. Could you please provide this document and the accompanying work statement for the record?

Answer: See enclosure 2.

Man Versus Advanced Automated Technology Costs On Space Station

Question: Page RD 1-1 of your budget justification contains a distribution of the $150 million for the Space Station program.

Could you please provide a breakout of the funds requested in each of the six functional areas that would be associated with a development of systems design to support the life functions and activities of man versus the funds devoted to advancing the state-of-the-art in automation, robotics, expert systems and other information processing activities?

Answer: The definition effort proposed by NASA in FY 1985 is designed to generate the detailed information requested. It is currently estimated that approximately $10 million of the $150 million will be devoted to the general field of automation, robotics and artificial intelligence. Further, it is estimated that 10 to 15 percent of the overall definition and development funding will be devoted to crew related activities.

Question: On page RD 1-3 of your budget justification, you state that there is a "recognized need to optimize the synergistic effects of the man/machine combination in space via automation, robotics, and artificial intelligence technology". How much in the way of resources and workyears does NASA intend to devote to these issues during FY 1984, FY 1985, and FY 1986?

Answer: In FY 1985, we currently estimate that approximately $10 million of the Space Station proposed $150 million will be devoted to the general fields of automation, robotics and artificial intelligence. A more precise assessment, as well as our plans for FY 1986, will be developed following the FY 1984 robotics study that NASA is undertaking at the request of the Senate Appropriations Committee.

Question: What specific robotic technologies will be targeted for advancement and incorporation into the Space Station design?

Answer: Examples of the technologies that will be targeted for advancement and incorporation into the Space Station design include more powerful computers, expert system software and sensor development both visual and tactile.

Question: Please answer the above questions for expert systems, automation, and artificial intelligence.

Answer: Examples of the technologies that will be targeted for advancement and incorporation into the Space Station design include more powerful computers, expert system software, and sensor development both visual and tactile.

Question: How much money is NASA applying to university-based research in the areas during FY 1984 and FY 1985?

Answer: The Space Station will commit approximately $.5 million into university research for these technologies as part of the FY 1984 study requested by the Senate Appropriations Committee. In addition to these resources, the Office of Aeronautics and Space Technology has committed $700,000 resources to these fields. The level of effort in FY 1985 will be partially determined by the results of this study.

Question: In describing your Advanced Development program, you state that an objective of this program is to "develop and apply automation technology to optimize capabilities for fault detection and isolation, on-orbit repair and routine operation, an maximum user utility". How much will be provided for these advanced development program during FY 1985?

Answer: The FY 1985 Advanced Technology program totals $65.4 million and will be looking at the following areas: systems/operations; data management; environmental crew and life support; power; thermal; human productivity; auxiliary propulsion; attitude control and stabilization; structures/mechanisms; and, communications. The Space Station will be designed to use telepresence, advanced optical sensors, and other devices that would facilitate the maintenance and servicing of space assets. The degree of automation incorporated into the baseline Space Station will be determined based upon the state-of-the-art at the time of the technology freeze in FY 1987. Every effort is being made to be certain that maximum advantage is taken to ensure that the Space Station envisioned by NASA is a facility in space that will be capable of being upgraded incrementally as technology becomes available. The design concept will provide for this potential evolutionary growth and improvement.

Space Stations System Definition/Integration

Question: Your budget justification indicates that your systems definition/integration on the Space Station will be divided into two to four work packages. Your current plan calls for two contractors to be selected for each work packages for the Phase B studies. This would result in four to eight contractors being involved in these studies. At this point, have you better defined the number of work packages and number of contractors that will be associated with your systems definition/integration effort during FY 1985? How much of the $150 million have you programmed for these studies? What percent of these contracts will be devoted to manned life support and associated systems?

Answer: The definition of the work packages will be refined during the next two to four months and, pending favorable action on our FY 1985 budget request, a final decision will be incorporated into the release of a request for contractor proposals, currently planned for the end of July, 1984. Our planning still calls for two to four work packages with two contractors per work package. Of the $150 million, $52 million of the FY 1985 budget request is for these Phase B contracts. During FY 1985, approximately 10 percent of the Space Station budget will be spent on the definition of crew related facilities. Over the entire definition and development of the Space Station, it is estimated that 10 to 15 percent of the budget will be spent on crew-related facilities and activities.

Space Transportation System Program Requirements For Headquarters

Question: Your current operating plan for FY 1984 estimates $116.7 million for your Space Transportation Systems program at Headquarters. In FY 1985, you are estimating that the Headquarters component of this program will increase to $144.9 million. How do you explain this 24 percent increase?

Answer: The increase of approximately $28 million is related to two factors: (1) Funds for the main engine technology program and the Advanced

Extravehicular Mobility Unit (AEMU) are being managed out of Headquarters until there is a better definition of the tasks to be assigned, and to the centers. (2) Over 60 percent of the FY 1985 request identified to Headquarters represents program reserves that have not yet been allocated to the field centers. These reserves are allocated to the centers during the operating year as required. A majority of the FY 1984 reserves have been distributed to the centers at this time, accounting for the apparent increase in FY 1985 Headquarters funding.

Private Sector Investment in Space Activities

Question: In your opening statement, you note that one of the reasons for proposing a Space Station is that your Shuttle operations have "stimulated great interest to the private sector to look towards investments in future space activities". Could you please list each of the private sector activities that have been conducted on the Space Shuttle that could not have been performed, with equal effectiveness on a free flyer launched from an ELV?

Answer: The McDonnell Douglas continuous flow electrophoresis system (CFES) will be flown on numerous Shuttle flights. This payload could not have been flown on an ELV. The payload includes a fluid systems module, an experiment control and monitoring module, a sample storage module and a pump/accumulator package along with miscellaneous equipment that is stowed in a standard storage locker. The experiments will be flown mid-deck and will require crew access on-orbit to activate, monitor and control the operation of the CFES. The system requires return to earth of the processed materials.

Firms that expect to use the Shuttle in the near future include 3M and Lovelace Medical Foundation. 3M plans to use the Shuttle for R&D efforts aimed at the production of materials with commercial potential. These experiments require astronaut participation and return to earth of the processed materials.

The Lovelace Medical Foundation is working with certain aerospace firms to develop their experiments relating to the separation of biological materials for medical applications of great public importance. In all cases, these experiments require astronaut operations and return to earth of processed materials.

There have also been a number of private sector activities successfully conducted in Getaway Special (GAS) canisters aboard the Space Shuttle that could not have been performed, with equal effectiveness on a free flyer launched from an ELV. The following is a chronological list of these activities:

1. June 27, 1982 (STS-4) - Utah State University/ Weber State College/HDR Sciences/Gilbert Moore. Two studies:

    a. Duckweed root growth
    b. Composite curing and soldering

2. April 4, 1983 (STS-6) - Park Seed Company. Test of severe temperatures and cosmic radiation on 46 different varieties of seeds.

3. June 18, 1983 (STS-7) - Kayser-Threde (Germany). Five experiments:

    a. Growth of crystals in a liquid salt solution
    b. Nickel catalysts containing a mixture of raw materials and dry nitrogen
    c. Plant contamination by heavy metals on water-cress
    d. Cosmic radiation on plant seeds
    e. Microprocessor sequences test

4. June 18, 1983 (STS-7) - Purdue University. Three experiments:

    a. Nuclear particle penetration of sensitive plastic sheets
    b. Sunflower seed germination
    c. Fluid dynamics of mercury in a clear liquid

5. June 18, 1983 (STS-7) - California Institute of Technology. Two experiments:

    a. Radish seed growth
    b. Mixture of oil and water

6. June 18, 1983 (STS-7) - Edsyn, Inc. Nine soldering and desoldering experiments.

7. August 30, 1983 (STS-8) - The Asahi Shimbun (Japan). Experiment on artificial snowflake crystals.

8. February 3, 1983 (STS-11) - GTE Laboratories. Study of optical and electrical properties of arc discharge lamps in absence of convective effects.

9. February 3, 1983 (STS-11) - Utah State University. Study of thermo-capillary flow in liquid columns and capillary waves on water surfaces.

10. February 3, 1983 (STS-11) - Aberdeen University (Scotland). Three experiments:

a. Spore growth
b. Three-dimensional brownian motion
c. Dimensional stability

11. February 3, 1983 (STS-11) - AIAA. Three experiments:

a. Characteristics of separation of solder and flux in space.
b. Crystallization of protein
c. Germination of radish seeds

Also, there have been seven student experiments flown on the Shuttle:

1. Growth of perifera in zero gravity.

2. Effect of space travel on levels of trivalent chromium in the body.

3. Formation of crystals in a weightless environment.

4. Effect of exercise, diet, and zero gravity on lipoprotein profiles.

5. Insect flight motion study.

6. Convection in zero gravity.

7. Effects of weightlessness on arthritis

Second Sourcing of Shuttle Systems

Question: What plans, if any, do you have to seek a second source for the Space Shuttle Main Engine, Solid Rocket Boosters, or the External Tank?

Answer: The possibility of recompetition has always been an integral part of our long-range procurement strategy on all our contracts. Recompetition of SRB reusable hardware processing is underway with the proposals that were received March 15, 1984, currently undergoing source selection evaluation. On the main engine program, we have initiated activities to solicit competitively developed engine components that could provide alternative sources for key components or assemblies. On the other contracts, we have not made long-term commitments that could preclude our achieving even greater savings through creative and innovative techniques/processes and cost applications. The continued use of production "block buying" is one way to avoid making long-range commitments while keeping recompetition alternatives open. If we find through studies that savings could be gained without degradation of performance, while maintaining reliability and safety, we would want to pursue those possibilities.

Space Shuttle Flights in FY 1984

Question: Given your most current flight manifest, how many flights do you anticipate in FY 1984? How many do you anticipate in FY 1985?

Answer: We anticipate seven flights in FY 1984 and eleven flights in FY 1985. There are uncertainties, however, created by the performance problems in the PAM-D and IUS upper stages that could cause a rephasing of flights between FY 1984 and FY 1985.

Question: How many DOD flights do you currently have on the manifest for each year beyond FY 1984?

Answer: The Shuttle manifest included flights for FY 1984 through FY 1986. All other flight assignments shown in FY 1987 and beyond reflect the Shuttle planning schedule and are used for planning purposes. The basis of these flights are Form 100's submitted by DOD.

The equivalent DOD flights included on the Shuttle manifest and planning schedule include:

FY 1985 - 1.0
FY 1986 - 4.0
FY 1987 - 3.9
FY 1988 - 8.7

Shuttle Flight Rate

Question: As we know, your flight rate model for the Space Shuttle assumes that there will be 24 flights per year by FY 1989. That model also assumes that about 20 of these will be from Kennedy and the remainder from Vandenberg Air Force Base. Recently, there has been considerable discussion about the Air Force's procurement of 10 Titan Expandable Launch Vehicles.

What is the implication of reactivating such an ELV capability on the projected STS flight rate?

Answer: The DOD is currently proposing to launch two Titan/Centaur launch vehicles per year from KSC beginning in 1988. These Titan/Centaur flights would be for payloads which will be dual compatible with the Titan/Centaur and the STS/Centaur and would, therefore, result in the cancellation of one dedicated STS/Centaur flight for each Titan/Centaur launch.

Space Shuttle Economy Improvements

Question: One of the objectives of your Shuttle Production and Operational Capability program is the identification of improvements to make space transportation more economical. What is the current cost per flight, in terms of expendables and manpower--excluding payload considerations? How does this compare to the cost associated with STS-1 and STS-2?

Answer: In FY 1984, the average total cost per flight is expected to be approximately $210-235 million in FY 1983 dollars. Of this amount, consumables represent half of the cost and the balance is manpower intensive launch and flight operations, network support and allocations of center R&PM. Accounting records are not segregated for each unique flight because of the varying activities and timeliness associated with each aspect of operations, (hardware production, orbiter SRB refurbishment, launch operations, flight software preparation, training, etc.). The comparable costs of STS-1 and STS-2 are not available since we did not segregate the Research and Development activities from those activities associated with cost per flight. In order to provide a comparison of previous costs, the estimated total cost per flight is for the initial year of Shuttle operational flights, FY 1983, is approximately $375 million FY 1983 dollars.

Question: What are your costs, goals and objectives for these activities in 1989? What specific activities do you expect to undertake during FY 1985 to reduce these costs?

Answer: The Agency has a formally stated goal to "Make the Space Transportation System fully operational and cost effective in providing routine access to space for domestic and foreign, commercial and Government users." Efforts are underway within the Office of Space Flight to establish specific FY 1985 cost targets with the centers for cost improvement in the Shuttle Operations area. Examples of ongoing programs to reduce operational costs are listed below:

o Investments in facilities and equipment have been made to optimize turnaround at KSC and JSC.

o The consolidation of the various contractors into the Shuttle Processing Contract at KSC and STS Operations Contract at JSC for optimization of operations.

o Continual assessment of turnaround capability through the Shuttle Turnaround Analysis Group (STAG) to identify problem areas and take necessary corrective action at both KSC and JSC.

o Recompetition of the Solid Rocket Booster contract.

Filament Wound Case

Question: What is the current status of the filament wound case program in terms of costs and scheduling?

Answer: Although the filament wound case program is on a tight schedule, it is still on target in terms of supporting the first launch from the Vandenberg Launch Site by October 1985, and within the budgeted costs of $256 million.

Question: What major problems still remain to be resolved before the October, 1985, delivery date?

Answer: No known major technical problems remain to be solved. However, fabrication and testing are on a very tight schedule with little contingency for unanticipated problems. Completion of the structural test article testing and three static firings are the major milestones remaining.

Question: When will we have enough experimental information to ascertain the reuse potential of the filament wound case?

Answer: A reuse capability assessment is to be provided by the contractor as part of the filament wound case development effort later this calendar year. The number of reuses expected cannot be determined until the recovery and engineering analysis of the effects of launch, flight, and water impact on the filament wound case for at least two flights.

Question: How much are you requesting for the filament wound case program during FY 1985?

Answer: The FY 1985 funding request for the filament wound case program, including program integration, is $74 million.

Fourth Orbiter Delivery

Question: When do you expect the delivery of the fourth orbiter, the Atlantis, during 1984?

Answer: Atlantis is planned for delivery during December, 1984.

Criteria for the Procurement of Spares

Question: To what extent is your spares procurement policy being driven by the test and flight experience data and your estimates of mean time between failure versus your policy to insure long term operational viability of the four-orbiter fleet by providing major structural components in the event of damage?

Answer: The spares procurement policy is basically made up of two programs. One program, the structural spares program, has been implemented to procure a set of large structural elements that could be used as spares for the four orbiter fleet in the event of major structural damage. This structural spares program is particularly important in providing long-term launch assurance because of the long-lead times involved in producing these components. The availability of these parts will reduce the impact caused by structural damage to an orbiter. These elements could also be used as parts of a fifth orbiter, should a decision be made to proceed with such a procurement.

The other major program is the acquisition of logistical spare parts and a repair capability to support the fleet on both a flight rate and number of vehicles basis. It is this program that is driven by such measures as test and flight experience data and estimated mean time between failures.

Both programs are designed to provide long-term operational viability to the orbiter fleet and have been implemented on their own merits.

Question: How much of the spares money in your FY 1985 budget is based on test and flight experience data and how much is based on the decision to secure additional large structural components, such as crew module, mid and aft fuselage sections, payload bay doors, etc.?

Answer: In the FY 1985 budget, the request for the structural spares program is $120 million and for the orbiter logistical spares program $289 million.

The structural spares program is designed to provide long-term launch assurance in the event of structural damage to an orbiter. Availability of these elements will reduce the impact that a structural damage mishap would otherwise cause.

The logistics program, on the other hand, is designed to keep the four orbiter fleet in operational status by providing spare parts. The procurement of these spares is based on test and flight data. The phasing of the procurements may be affected by other considerations, such as continued contractor production capability.

Question: What is the production lead time associated with each of the major structural assemblies that you intend to procure during FY 1985?

Answer: The production lead times for the various structural spares elements are as follows:

Element	Production Time-Months
Aft Fuselage	43
Crew Module	46
Lower Forward Fuselage	49
Upper Forward Fuselage	53
Forward RCS Module	48
Payload Bay Doors	53
Vertical Stabilizer	45
Wings	45
Mid-Fuselage	34
OMS Pods	52
Body Flap	35

FY 1983, 1984, and 1985 Total Shuttle Spare Parts Requirements

Question: Last year in our hearing, I asked you what will be the total three year (FY 1983-FY 1985) cost for implementing your Shuttle spares policy. At that hearing, you told us that the three year total for orbiter spares would be $300 million and $120 million would be required for structural spares. What is the new total for these three years including the estimates contained in your FY 1985 justification? How many individual components are there on your spares lists inventory? What percentage of these items have established mean time to failure data on which a replacement policy could be based?

Answer: Orbiter spares funding for FY 1983-FY 1985 is as follows (real year dollars in millions):

	FY 1983	FY 1984	FY 1985
	(real year dollars in millions)		
FY 1985 Budget			
Structural Spares	20	100	120
Other Spares	133	215	289
FY 1984 Budget			
Structural spares	20	100	120
Other Spares	132	168	179

There are approximately 57,000 flight hardware line items in the orbiter logistics program. The 57,000 line items are made up of approximately 500 major line replaceable units (LRU), 9,500 minor line replaceable units and shop replaceable units (SRU), and 47,000 piece parts.

The LRU and SRU spares requirements are based on test data and the limited flight data, thus far. As the flight experience expands, the failure data will be updated and adjustments to spares procurements will be made. Other considerations, such as maintaining contractor manufacturing capability and long-lead times for production, are also included when spares procurement program is baselined.

Space Shuttle Main Engine Improvements

Question: You are undertaking a program of incremental improvements to the Space Shuttle main engine system. What is the level of investment that you intend to make in this area during FY 1985? What are the changes and deliverables that you expect to result from this level of investment?

Answer: The investments in development of the main engine are targeted to solve the life related problems discovered during verification testing at 109 percent. The initial effort (Phase II) is focused on extending high pressure turbopump usage from the current 2 to 4 mission usage to a minimum of 10 mission usage. This will be accomplished by modification to the pumps themselves. The longer term effort (Phase III) is attacking the root cause of the limited life, i.e., the high temperatures and pressure in the engine system. This will involve changes to the powerhead and main combustion chamber, which require substantially more time to incorporate. The improved pumps from Phase II will be certified and available for service in the FY 1986 timeframe, and the improved Phase III engine will be certified in the FY 1989 timeframe. The level of investment in FY 1985 is $117 million for both the Phase II and Phase III developments.

Question: Have you considered the necessity of requiring a second source to assist in this improvement program?

Answer: We have structured our development program to include competition. We have released a request for proposal, RFP, for initial studies in FY 1984 on engine improvements. If the study reports indicate that substantial gain can be made through alternate sources, a follow-on program engineering design and verification testing will be initiated in FY 1985.

Orbiter Main Engine Reuse

Question: At last year's hearing, you indicated that you expect 55 flights per main Shuttle engine. What is your current estimate for the number of flights per engine?

Answer: There is no easy, single number that can be assigned for the life of an orbiter main engine. We have found that it is effected by the thrust level and is different for several of the primary components which make up the main engine. We are currently planning 40 flights per engine in our long range life projection. With the exception of the high pressure pumps, the major components are achieving that value in ground test.

Orbital Maneuvering Vehicles

Question: What specific design consideration or constraints have you identified relative to the orbital maneuvering vehicle? How much money do you intend to allocate for this activity during FY 1984 and FY 1985?

Answer: The OMV will be flown aboard the orbiter and must, therefore, be designed to fit payload bay physical constraints. Further, there are clear cost and manifesting advantages in minimizing the length the vehicle occupies in the bay. Apart from these considerations, NASA has imposed very few specific design restrictions on the vehicle. Our Phase B Request for Proposal (RFP) calls for a vehicle capable of performing a number of reference missions (defined in the RFP), and of exhibiting certain operational, serviceability, and lifetime characteristics. Contractors are expected to explore a wide range of system and configuration options in the design of a vehicle to meet these goals.

A total of $5 million of FY 1985 funds has been allocated for Phase B contracts, which will run from July, 1984 to July, 1985.

Question: Given your current plans, when would you expect such a vehicle to be available for actual use? What is the expected cost associated with the development of such a vehicle?

Answer: Based on the results of the Phase B studies and assuming that the project is initiated as an FY 1986 initiative, the first flight unit could be available during CY 1990. Total cost is projected to be approximately $350-$375 million.

Manned Maneuvering Unit

Question: What additional development or production costs are contained in your FY 1985 budget request for the manned maneuvering units?

Answer: The FY 1985 budget request contains the following estimated costs for the remaining development and production of the Manned Maneuvering Units.

Caution and Warning	
FY 1985	1.6
FY 1986	2.7
FY 1987	3.0
FY 1988	2.5
FY 1989	---

The estimated costs represent the design, development, and installation of a caution and warning system/digital control electronics assembly for those units. These same requirements were included in the runout of the FY 1984 budget.

Question: What is your best, current estimate of the total development and fabrication cost of these units?

Answer: The current estimate of the total development and fabrication costs of one qualification test unit and the two flight units is $45 million. Additionally, $26 million was included in the MMU contract for the development of an orbiter tile repair kit. In addition, there is $10 million requested for FY 1985-1988 for the design, development, and installation of a caution and warning system/digital control electronics assembly for those units.

Vandenberg Air Force Base Shuttle Launch Complex

Question: What is the status of the activities at Vandenberg Air Force Base and what major items still remain to be completed?

Answer: The status, as reported by the Air Force, is that activities are on schedule for an October, 1985, initial launch capability and the schedule is tight but achievable. The Air Force is the responsible DOD agency for the development of Vandenberg and can best provide information on major items remaining to be completed at Vandenberg.

Question: What is the most recent cost estimate for the total Vandenberg program? What cost contribution, if any, does NASA intend to make towards the development at Vandenberg during FY 1984 and FY 1985?

Answer: Based on unofficial data provided by the DOD, the estimate is $2.8 billion of nonrecurring costs. This estimate should be confirmed by the Air Force--the developer of Vandenberg.

NASA's role in the development of Vandenberg is one of support to the Air Force, as requested. NASA civil service is being used to assist in the activation and planning activities at VAFB. All travel and TDY costs are reimbursed to NASA. KSC, on a reimbursable basis, will do the processing of the first three flights of OV-103 from Vandenberg Air Force Base. KSC is also procuring, on a reimbursable basis, the non-site unique GSE for VAFB.

Question: What is the most current estimate as to the assumed operational date for Vandenberg?

Answer: The Air Force reports that the October, 1985, launch date will be met for the initial launch capability. Vandenberg is to be fully operational at the landing of the third STS flight at Vandenberg.

Question: What is your current estimate as to the expected orbiter turnaround time at Vandenberg versus the expected turnaround time at the Cape?

Answer: The most current Air Force turnaround assessment for mature VAFB operations is 69 workdays - based on five days/two shifts. However, the current planned flight rate from Vandenberg does not drive turnaround times as is the case at the Cape. Further, turnaround processing for the first three Vandenberg flights will be done at Kennedy Space Center and ferried to Vandenberg for flight processing. The most current NASA turnaround assessment for KSC is 35 working days, with a goal of 28 working days by STS-30.

Centaur G Upper Stage

Question: What are the most current schedule and cost estimates for Centaur G and G-prime upper stage vehicle?

Answer: The NASA Centaur G-Prime vehicles for Galileo and ISPM are currently scheduled for acceptance from the contractor in July and September 1985, respectively. The DOD Centaur G vehicles are scheduled for acceptance in September and November 1986. The NASA G vehicles for VRM and TDRSS E are scheduled for acceptance in late calendar year 1987.

The estimated cost to NASA to cover hardware production, contractor launch support, KSC support, contingency, and other miscellaneous support for two G-Prime and two G vehicles and two Centaur Integrated Support Structures (CISS) for the G-Prime vehicles is $313 million.

The estimates to DOD to cover hardware production, contractor launch support, KSC support, contingency and other miscellaneous support for two G vehicles and two G CISS's is $183 million.

Question: How much is included in your FY 1985 budget request for the Centaur G development program?

Answer: The budget in FY 1985 for Centaur development is $3.8 million in NASA resources and anticipated reimbursements from DOD of approximately $69 million.

Centaur Engine Development

Question: How much money have you allocated in FY 1984 for work required on the RL-10 engine? What specific types of upgrading are you pursuing on the RL-10?

Are there any funds in your FY 1985 budget for the continuation of work on the RL-10 engine?

Answer: The FY 1984 budget contains $3.0 million for the RL-10 engine development.

There are three primary options currently being pursued in the RL-10 development program.

o The development of a multi-mode low thrust capability which will provide the option of tailored thrust for transfer of fragile payloads to geosynchronous orbit;

o development of an extendible high area ratio nozzle, which increases specific impulse by about 20 seconds, which equates to an increased payload capability of approximately 1000 pounds; and

o shortening the engine chamber by approximately 15 inches to permit improved engine/vehicle packaging with consequent increase in payload length capability. The shorter (55-inch) package accommodates the extendible nozzle in the same envelope.

We have requested another $3 million in FY 1985 for continuation of this work.

Second Spacelab Costs

Question: What are the estimated total costs associated with the U.S. purchase of a second Spacelab unit and how are these costs distributed over the procurement period?

Answer: The estimated total costs associated with the U.S. purchase of a second set of Spacelab hardware including both the module and igloo pallet configuration and the instrument pointing system is $236 million. The cost distribution over the procurement period is thus:

	($ in millions)
FY 1983 (and prior)	$187
FY 1984	24
FY 1985	20
FY 1986	5
TOTAL	$236

Remote Satellite-Servicing

Question: One of the activities discussed under your Space Transportation System-Advanced Programs is the remote servicing of satellites. You state that such servicing would extend the Shuttle's operational capability for remote low and geosynchronous earth orbiting support of spacecraft and platforms. How much do you intend to devote to this area of remote servicing during FY 1984 and FY 1985? To what extent could these remote servicing devices be controlled from the ground, the Space Shuttle and a Space Station?

Answer: The area of remote satellite servicing is funded with $100,000-200,000 in FY 1984, and with $300,000 in FY 1985.

Regarding possible remote control modes, all control options are still open and are subject to various study trades underway. Ground and Space Station control modes seem to offer certain advantages in that Shuttle crewmen are apt to be otherwise occupied with subsatellite launches, in-bay experiments, or other timeline-related duties.

Shuttle Training Aircraft

Question: Your FY 1985 budget contains funds for the modification of a third Gulfstream II for use as a Shuttle training aircraft (STA).

How much money is included in your FY 1985 budget for procurement and modification costs for this third Gulfstream? When will the aircraft be available for use as a training aircraft given your current schedule and plans?

Answer: The FY 1985 STA budget contains $1.7 million to complete the modification of the third STA which was procured in FY 1983.

The third STA total procurement and modification costs are projected to be $28.3 million.

The third STA will be ready for training in July, 1985.

Question: Please provide, for the record, the number of flight hours on the first and second Gulfstream II currently at use at NASA during FY 1983 and your expected number of flight hours for training on each of these aircrafts during FY 1984.

Answer: The flight hours for training on the two STA's in:

FY 1983 (actual)	FY 1984 (projected)
A/C 946 -- 785 hours	A/C 946 -- 750 hours
A/C 947 -- 714 hours	A/C 947 -- 750 hours

Question: Please also provide, for the record, the number of hours of maintenance on each of the Gulfstreams during FY 1983 and the expected number of maintenance hours during FY 1984?

Answer: The number of maintenance days for the two STA's in:

FY 1983 (actual)

A/C 946 -- 67.8 (scheduled) 56.5 (unscheduled)
A/C 947 -- 52.6 (scheduled) 44.1 (unscheduled)

FY 1984 (projected)

A/C 946 -- 73 (scheduled) 60 (unscheduled)
A/C 947 -- 70 (scheduled) 60 (unscheduled)

Question: Based on the above data, how much available flight time is unused on each of these two Gulfstreams?

Answer: Based on supporting data, all available flight hours are fully committed to training or weather support, except for time in flight which is consumed in hardware checkout and in ferrying the aircraft to and from the appropriate training sites and to and from the required maintenance site.

Space Shuttle Flight Operations

Question: Your FY 1984 budget requested $315 million for Space Flight Operations. Your FY 1984 operation plan contains a estimate of $323.9 million for this activity, or an increase of $8.9 million. One of the reasons given for this increase is that less learning than anticipated occurred in streamlining and reducing the number of pre-flight planning cycles in the flights last mission design process. What have you done in order to assure that the savings anticipated to occur through learning will, indeed, materialize in the future?

Answer: The original estimate was based upon the assumption that the STS flights would be similar and the operations required to support them would be similar. This similarity of flights and stability in the manifested cargoes has not yet occurred; thus, the experience (learning) gained in supporting a flight has not been as beneficial to supporting the subsequent flights as was expected. In the cases where we have had similar or repeat flights and the cargo configuration on the flights stayed relatively constant through the planning cycle, for example STS-5 and STS-7, we did realize significant improvements. As the flights start to occur more frequently, they will, of necessity, become more similar and the cargoes manifested will stabilize resulting in the savings through learning. In an attempt to capture, retain, and concentrate our experience base, we have implemented a program to consolidate the operations support contracts at both KSC and JSC.

Center Costs for Space Transportation Capability Development

Question: Page RD Sum-8 of your budget justification shows a distribution of your FY 1985 budget plan by installation for each program and project. Under Space Transportation capability development, each one of the installation shows a decrease from the FY 1984 level except for Johnson Space Center (JSC). Could you please explain why the Space Transportation capability development costs at JSC have increased, while the costs at each of the other centers has decreased?

Answer: The major program elements under Space Transportation Capability Development are Upper Stages, Spacelab, Payload Operations and Support Equipment and Engineering and Technical Base (ETB). The major changes from FY 1984 to FY 1985 are the decreased funding requirements for the Spacelab and Shuttle Centaur development programs. Prime responsibility for these activities has been at Marshall, Lewis and Kennedy. Johnson has had relatively minor integration responsibilities for these programs. The increase at Johnson primarily reflects the impact of inflation on supporting the ETB requirements.

Question: What specific activities and functions are being performed at JSC during FY 1985?

Answer: The FY 1985 Space Transportation Capability Development funding for the Johnson Space Center by major activity is shown in the following table:

	($ in millions)
Upper Stages	1.0
ETB	71.8
Spacelab	8.8
Payload Operations and Support Equipment	29.4
Advanced Program	4.3
TOTAL	115.3

Question: Can you indicate what the outyear costs associated with these functions will be during FY 1986, FY 1987, FY 1988, and FY 1989?

Answer: The following table provides the outyear estimates associated with the FY 1985 budget for the

Space Transportation Capability Development activities at Johnson Space Center:

	($ in millions) FY 1986	FY 1987	FY 1988	FY 1989
Upper Stages	1.2	---	---	---
ETB	73.9	76.9	79.9	83.7
Spacelab	13.7	16.0	16.6	17.4
Payload Operations and Support Equipment	20.1	21.5	20.0	19.1
Advanced Programs	6.5	6.7	7.4	7.5
TOTAL	116.0	121.1	123.9	127.7

Question: Does NASA currently have any plans to consolidate these functions at KSC?

Answer: There are no plans to consolidate these activities at Kennedy Space Center.

Space Flight Control and Data Communications Budget

Question: Could you please project your expected Space Flight Control and Data Communications budget for FY 1986 and FY 1987?

Answer: The FY 1985 budget request for Space Flight Control and Data Communications in the Office of Space Flight is $3.166 billion. Based on the projected runout of the FY 1985 budget, this is expected to decrease to $2.937 billion in FY 1986 and further decrease to $2.200 billion in FY 1987. The decrease is attributable to the decrease in production requirements with the completion of orbiter production and of the second line of launch support equipment at Kennedy Space Center and the anticipated increase in reimbursements for Shuttle standard services based on our budgeted mission model assumptions.

Shuttle Processing and Launch Capability at Kennedy Space Center

Question: You are currently phasing in the second line of vehicle processing stations at the Kennedy Space Center to support the launch processing of two or more orbiters simultaneously. Could you please provide, for the record, a description of a major facilities required in order to support the Galileo and International Solar Polar Missions planned for 1986?

Answer: The enclosed table (enclosure 3) lists the major facilities and their modifications required to support the Galileo and International Solar Polar

Missions. These modifications are required because of the use of the Centaur upper stage, not the spacecraft requirements.

Question: Could you also provide an estimate of the cost for each of these facilities and their scheduled availability?

Answer: Enclosure 3 also lists the costs of modifications and scheduled readiness dates for each of the facilities listed. Modifications are not unique to the Galileo and ISPM missions but apply to all Centaur missions.

Science, Applications and Planetary Launches

Question: Please prepare, for the record, a list of your science, applications, and planetary launches by fiscal year from FY 1984 through FY 1994.

Answer: The January 1984 Manifest/Planning Schedule contains 79 science, applications, and planetary payloads scheduled through FY 1994, as follows:

FY 1984

ERBS - Earth Radiation Budget Satellite
LDEF-1 - Long Duration Exposure Facility
LFC - Large Format Camera
OAST-1 - Office of Aeronautics and Space Technology
OASTA-3 - Office of Space and Terrestrial Applications
SMM Repair - Solar Maximum Mission Repair
SPARTAN-1 - Shuttle Pointed Autonomous Research Tool for Astronomy

FY 1985

EASE/ACESS - Evaluation of Assembly of Simple Structures in Space during EVA
EOM-1 - Environmental Observation Mission
GAS Bridge - Getaway Special structure across Shuttle bay
LDEF-1 RETR - Long Duration Exposure Facility Retrieval
LFC - Large Format Camera
MSL-1 - Materials Science Laboratory
MSL-2 - Materials Science Laboratory
SPACELAB-2
SPACELAB-3

FY 1986

ASTRO-1 - Halley's Comet Intercept Mission
GALILEO - Jupiter Interplanetary Probe
LANDSAT RETRV - Land Satellite Retrieval
MSL-3 - Materials Science Laboratory
OSTA-5 - Office of Space and Terrestrial Applications
SPACE TELESCOPE
SPACELAB-4
SPARTAN-2 - Shuttle Pointed Autonomous Research Tool for Astronomy

FY 1987

ASTRO-2 - Halley's Comet Intercept Mission
ASTRO-3 - Halley's Comet Intercept Mission
CFMF-1 - Cryogenic Fluids Management Facility
EOM-2 - Environmental Observation Mission
IML-1 - Spacelab
LDFF-2 - Long Duration Exposure Facility
MSL-5 - Materials Science Laboratory
MSL-6 - Materials Science Laboratory
MSL-8 - Materials Science Laboratory
OAST-2 - Office of Aeronautics and Space Technology
OAST-3 - Office of Aeronautics and Space Technology
OSTA-7 - Office of Space Terrestrial Applications
SPARTAN-3 - Shuttle Pointed Autonomous Research Tool for Astronomy
SUNLAB-1 - Spacelab
SUNLAB-2 - Spacelab

FY 1988

CFMF-2 - Cryogenic Fluids Management Facility
CFMF-3 - Cryogenic Fluids Management Facility
COBE - Cosmic Background Experiment
EOM-3 - Environmental Observation Mission
EUVE - Extreme Ultraviolet Experiment
GRO - Gamma Ray Observation
LS LAB-3 - Spacelab
MSL-10 - Materials Science Laboratory
MSL-12 - Materials Science Laboratory
OSTA-9 - Office of Space and Terrestrial Applications
SHEAL-1 -Spacelab
SP PLASMA-1 - Space Plasma Lab
TSS-1 - Tethered Satellite System
VRM - Venus Radar Mapper

FY 1989 - FY 1994

Subsequent to FY 1988 specific flights have not been included in the official NASA planning schedule. At this time there are a number of candidate scientific payloads and the continuation of existing series such as EOM and SUNLAB. The planning horizon will be extended to FY 1989 and specific missions identified in preparation for the FY 1986 budget.

Planetary Exploration Research and Analysis

Question: This year you are requesting $54.5 million for your Research and Analysis activities within the Planetary Exploration program. In FY 1984, you requested $45.5 million for these activities. The Congress augmented this amount by adding an additional $14 million in FY 1984. In particular, you are requesting $37.9 million for supporting research and technology. This is below the $40.9 million contained in your operating plan for FY 1984.

What was your request to OMB for supporting research and technology for FY 1985?

Answer: NASA's request to OMB for the total Planetary Exploration Research and Analysis was $63.5 million, of which $46.4 million was designated for supporting research and technology.

Question: The FY 1984 add-on was used to continue at an enhanced level all of the Research and Analysis program. What specific activities will be reduced as a result of the proposed FY 1985 lower budget request level?

Answer: The following chart shows the differences between the FY 1984 and FY 1985 Research and Analysis funding:

	($ in millions)		
	FY 1984	FY 1985	Delta
Planetary Geology/Geophysics	11.2	10.5	-0.7
Planetary Atmospheres	6.8	5.8	-1.0
Advanced Programs	9.8	9.0	-0.8
Mars Data Analysis	5.5	4.3	-1.2
Instrument Definition	4.5	3.0	-1.5
Planetary Astronomy	8.1	8.0	-0.1
Halley's Comet Watch/Experiments	3.3	3.3	---
Planetary Material/Geochemistry	10.3	10.6	+0.3
TOTAL	59.5	54.5	-5.0

Multispectral Linear Array (MLA)

Question: During FY 1984, the Congress added an additional $1 million for the advanced technology activities associated with the development of a future high performance Multispectral Linear Array (MLA) to be used in remote sensing. Your budget justification indicates that the critical technology development in supporting research on the MLA will continue during FY 1985. What specific aspects of this program could be accelerated during FY 1985 and what would be the associated costs? How much have you included in your FY 1985 budget for the continuation of the MLA research? What was your request to OMB for this activity in FY 1985?

Answer: The MLA is currently scheduled for launch on the Space Shuttle in 1987; additional funds in FY 1985, therefore, would potentially allow for an earlier flight of the MLA.

Our Advanced Spectrometer development activity, which includes MLA research leading to a Shuttle flight in the 1987/1988 timeframe) is funded at approximately $12 million in the FY 1985 budget request. This is consistent with our FY 1985 OMB request.

Physics and Astronomy

Question: Please provide, for the record, a detailed list of each of your physics and astronomy programs that show an increase in FY 1985 over the FY 1984 level. Also indicate which of those programs involve international cooperative agreements. Also note in the listing those that involve items of particular interest to industry.

Answer: The listing follows:

	($ in millions)	
	FY 1984 Current Estimate	FY 1985 Budget Estimate
Gamma Ray Observatory Development	86.2	120.2
Spacelab Payload Development and Mission Management	80.9	105.4
Explorer Development	48.7	51.9
Mission Operations and Data Analysis	68.1	109.1
Research and Analysis	35.8	36.9
Suborbital Program	52.3	58.7

Increases in Explorer Development, Research and Analysis, and the Suborbital programs from FY 1984 to FY 1985 essentially reflect allowances for inflation, plus an adjustment for aircraft operations and maintenance costs necessary to support research flights within the suborbital program. The FY 1985 GRO estimate is based on a buildup of fabrication and assembly efforts over FY 1984 and leading to a launch in 1988. The FY 1985 Spacelab Payload Development and Mission Management funding level reflects an increase in the development and mission management activities over FY 1984 in support of the planned Shuttle/Spacelab Science Payload Missions. The increase in Mission Operations and Data Analysis from FY 1984 to FY 1985 reflects the buildup of Space Telescope (ST) operations in support of the 1986 launch of ST, and a buildup in the maintenance and refurbishment activities in support of future required on-orbit maintenance/refurbishment of the Space Telescope.

The Gamma Ray Observatory, Spacelab Payload Development and Mission Management and Explorer Development all involve international participation.

In addition, these same three areas all involve items of particular interest to industry insofar as aerospace contractors typically develop (fabrication/manufacturing) systems and/or components for flight projects. Moreover, the Research and Analysis for FY 1985 includes funding for technology definition studies to be carried out by industry for future candidate missions such as the Advanced X-Ray Astrophysics Facility.

Tethered Satellite System

Question: How much money have you included in your FY 1985 budget justification for the U.S./Italian Tethered Satellite System program? How much has been allocated by the Italian government for this program during FY 1985? What specific activities will be undertaken during FY 1985 in conjunction with this program and when is a full flight demonstration expected to occur?

Answer: Approximately $21 million is included in our FY 1985 budget request for the U.S./Italian Cooperative Tethered Satellite System program (approximately $18 million for system development of the Tether deployment mechanism and $3 million for the development of science instruments). The Italian government has committed approximately $50 million U.S. dollars for this program ($40 million for the satellite development and $10 million for science experiments). Contracts were awarded in early 1984 for the hardware design and development of the Tether deployer and the satellite system; preliminary design reviews are scheduled in late 1984 for the satellite and the deployer system. The critical design review for the satellite and deployer are scheduled for late summer and during the fall of 1985, respectively. An engineering and science verification flight demonstration is scheduled for late 1987.

Sounding Rockets Program

Question: Last year in describing your sub-orbital programs in Physics and Astronomy, you made reference to a sounding rocket payload concept call "SPARTAN". Your FY 1984 justification indicated that you expected an initial launch of a SPARTAN payload in FY 1984. What is the current status of this payload?

Answer: The SPARTAN program is intended to provide hours-to-days of observation time to sounding rocket class payloads. The first mission to be undertaken under this program, SPARTAN-1, is scheduled for launch on the Space Shuttle in August, 1984. All preparations for launch are proceeding on schedule.

The complete science payload and carrier system have been assembled and have successfully completed a full electronic mission simulation. The SPARTAN-1 package is now undergoing environmental testing.

Question: Do you intend to pursue the "SPARTAN" concept in FY 1985; and, if so, how much have you programmed for this activity during FY 1985?

Answer: The SPARTAN program will be continued in FY 1985 to provide more flight opportunities to the science community. The second SPARTAN mission, SPARTAN-2 is currently scheduled for launch in late 1985. In FY 1985, additional mission assignments will be made. Our FY 1985 Budget request assumes at the SPARTAN program will be funded at the $5-8 million level.

Solar Maximum Mission (SMM)

Question: Your FY 1985 budget contains a request for $7.5 million for the Mission Operations and Data Analysis activities associated with the Solar Maximum Mission. Please provide a distribution of these costs by activity for FY 1985?

Answer: The $7.5 million requested in FY 1985 for the Solar Maximum Repair Mission include about $2.5 million to support operations of the repaired spacecraft, about $4 million for analysis of science data, and approximately $1 million to complete refurbishment of the ailing attitude control system module which is being removed and replaced during the repair mission.

Advanced X-Ray Astrophysics Facility (AXAF)

Question: Your budget justification states that during FY 1984, major emphasis is being given to the definition of the AXAF mission.

What level of activity is being undertaken during FY 1984, both in terms of dollars and staff years?

Answer: FY 1984 funding for AXAF is currently planned at about $6 million, with at least 50 staff years of effort.

Question: What level of activity do you intend to undertake during FY 1985 for this program?

Answer: Our current planned FY 1985 funding level is $8-$10 million.

Question: When would you expect to start your Phase B studies on the AXAF program?

Answer: Our current plans assume initiation of Phase B studies in June, 1984.

Question: What are your current estimates in terms of total cost for the completion of this mission?

Answer: Our preliminary estimate of the total AXAF mission cost is in the $700-$920 million range in dollars of the FY 1985 budget.

Balloon Activities

Question: During FY 1983, you launched 44 balloons from launch sites in the United States and Brazil. In FY 1984, you expect approximately 60 balloon flights. How many balloon flights are expected during FY 1985?

Answer: NASA currently plans to operate the balloon program at approximately the same level in FY 1985 as was flown in FY 1984 or about 60 balloon flights.

Question: What is the maintenance and operation cost for the National Science Balloon Facility at Palestine, Texas? How have these costs changed since FY 1983?

Answer: In FY 1985, the maintenance and operation cost is estimated at approximately $3.5-$4.0 million. In FY 1983, the maintenance and operation cost was $3.0 million. The projected increase is due to the following factors: (1) University Consortium for Atmospheric Research had provided administrative and management support at no cost through FY 1983, and (2) increased equipment costs required to replace obsolete instrumentation and telemetry systems.

Space Telescope Development

Question: Our FY 1984 report specifically cited some concerns about the need to coordinate NSF's and NASA's activities in the area of astronomy. Specifically the report states that the Committee, "is still concerned that the issue of the respective roles of NSF and NASA in astronomy has not been resolved. In particular, the Committee is concerned about the future of the Space Telescope. The Committee expects this facility to be available to the entire astronomy community through a broad-based peer review process. The Committee expects a joint NSF/NASA report on the process that will be used for the selection of principal investigators by March 1, 1984." What agreement did you reach with NSF relative to the role of the two agencies in using the Space Telescope--for instance, how will principle investigators be selected? What proportion of the viewing time will be devoted to scientists performing observations in support of NASA missions? Would you please summarize the agreement for us? Please submit a copy of the joint NASA/NSF study for the record.

Answer: Announcements of opportunity will be made every six months to all members of the astronomical community throughout the world. Investigators will then be selected through peer review panels, and the Science Institute will develop the peer review procedures for allocation of all observing time on ST.

Exact time not yet determined, but a balance between short and long-term programs of viewing and targets of opportunity will be coordinated. Enclosure 4 is a copy of the joint NASA/NSF study.

Summary of report is as follows:

Astronomers worldwide will use the Space Telescope (ST); ST Science Institute has responsibility for science operations as a contractor to NASA. The ST Science Institute will establish guidelines for ST use; select observers through an Announcement of Opportunity which will be released every six months and observers will be selected through a peer review process; develop observing schedule; publicize scientific data; establish program for visiting scientists. ST Science Institute scientific staff members will compete for observing time with other astronomers. Selected General Observers will be funded by NASA through the Science Institute for computer time, travel, graduate student support, etc., as NASA funds any other investigator conducting science for NASA.

NSF has lead-agency responsibility for ground-based astronomy. Proposals to follow-up ST discoveries with ground-based astronomy will be provided by NSF through normal review processes at each ground observatory.

NASA/NSF always coordinate astronomy research and ensure that the science community is involved in all aspects of the selection process.

Question: Last year, your budget request contained an estimate, of $120.6 million for the Space Telescope Development program. As a result of a series of overruns and schedule slips, your current FY 1984 operating plan contains $195.6 million for this program. In FY 1985, you are requesting $195 million. What was your original request to OMB the Space Telescope Development program during FY 1985?

Answer: The FY 1985 OMB budget request included $195 million for Space Telescope Development. The runout of the FY 1984 President's Budget assumed a FY 1985 funding level of $69.4 million for Space Telescope development activities.

Question: Will the amount that you have included in your budget request for FY 1985 be sufficient to maintain the Space Telescope's new schedule?

Answer: FY 1985 will be a challenging year for the Space Telescope program as assembly and verification activities will be conducted. The assembly and verification process involves integration and checkout of all major components of the Space Telescope system. Because of the complexity of this activity, this will inherently be a high-risk time in the development program. However, we believe the proposed FY 1985 funding request is consistent with the currently identified requirements and schedule.

Question: What are the estimated reserves that you have included in your FY 1985 request?

Answer: We would prefer to answer questions regarding Space Telescope development reserves off-the-record.

Question: How much of the FY 1985 request will be made available to the Space Telescope Institute?

Answer: The Space Telescope Science Institute funding requirements included in the FY 1985 budget request are approximately $15 million.

Question: How much have you included in your FY 1985 request for Mission Operations and Data Analysis and why are these funds necessary at this time?

Answer: Space Telescope activities budgeted under Mission Operations and Data Analysis consist of two elements: ST Operations ($49 million) and ST Maintenance/Refurbishment ($25.7 million). The ST Operations funding is primarily required for development of the ST Data Archival and Distribution System, the Guide Star Selection System, and the Science Operations Ground System; science institute staffing; and preparation of the mission operations control center for the Space Telescope launch. The ST Maintenance/Refurbishment funding is required for initiation of long-lead item procurements which are required for timely orbital maintenance, and for development of support service equipment needed for orbital maintenance.

Space Telescope Maintenance and Refurbishment

Question: Your FY 1984 operating plan contains $7.5 million for the maintenance and refurbishment for the Space Telescope. In FY 1985, you are requesting $25.7 million for this purpose. What specific activities will be performed and what specific components will be procured during FY 1985 to warrant this level of funding? What would be the impact on the program if this amount was reduced by $5 million?

Answer: Procurement of long-lead items is essential in FY 1985 in order to conduct Space Telescope orbital maintenance within a timeframe consistent with our current failure analyses. Some of the specific items for which funding is required follows: procurement of a number of orbital replacement units, including the Scientific Instrument Control and Data Handling unit, the high rate gyro assemblies, the spacecraft computer and batteries, and the reaction wheel assemblies, as well as development of special support equipment required during orbital maintenance. A reduction of $5 million in our FY 1985 request would, of course, affect our ability to be prepared for required maintenance and refurbishment of the Space Telescope.

Question: You are also requesting $49 million for Space Telescope operations. This represents an increase of $15 million over your FY 1984 operating plan. What specific activities do you intend to undertake during FY 1985 that warrant this level of funding? What would be the impact if this activity was reduced by $5 million?

Answer: Space Telescope Operations consist of four major elements: mission operations, science institute funding, system development, and support to scientific researchers. The FY 1985 requested funding is primarily required to fund the science institute efforts, and cover development cost of the science operations ground system, which will provide the computer support necessary for ST scientific investigations. The schedule leading to ST operational capability is very demanding, and any reduction in our FY 1985 requested funding level would jeopardize our ability to have a functional ground system and be fully prepared for Space Telescope operations at the time of launch.

Space Telescope Ground Systems

Question: How much money do you have in your FY 1985 budget for the Space Telescope Data Capture Facility and the Space Telescope Science Institute?

Answer: The FY 1985 budget request assumes a level of approximately $600,000. The Space Telescope Science Institute funding requirements included in the FY 1985 budget request are approximately $15 million.

Solar Optical Telescope

Question: Your budget justification indicates that the definition of the Solar Optical Telescope will be continued in FY 1985. How much have you programmed for the Solar Optical Telescope in FY 1985 and what is your current schedule and the remaining costs to completion?

Answer: The FY 1985 budget request assumes a level of $8-$10 million for the Solar Optical Telescope (SOT). The SOT project is currently under review; if we initiate development of SOT in the 1986 timeframe, we should be in a position to launch in the 1991 timeframe for a total estimated cost of approximately $250-$300 million.

Question: How much money had you planned to make available for the Solar Optical Telescope (SOT) in FY 1984 and FY 1985? What is the current schedule, including milestones, for SOT?

Answer: Our current plans assume a level of $6.0 million in FY 1984 and $8-$10 million in FY 1985 for SOT activities. These funding levels assume that SOT will remain in advanced definition during FY 1985 with initiation of development in 1986, leading to a launch in the 1991 timeframe. Options to initiate SOT development earlier than 1986 are currently under evaluation.

Search for Extra-Terrestrial Intelligence

Question: Could you please bring us up-to-date on the costs and plans of your Search for Extra-Terrestrial Intelligence program during FY 1985 and how this compares to the costs and activities undertaken during FY 1984?

Answer: The Search for Extra-terrestrial Intelligence (SETI) activities are continuing. The FY 1985 budget request assumes that SETI activities will be continued at the FY 1984 funding level of about $1.5 million. Both the FY 1984 and the planned FY 1985 activities are being focused on development of prototype analytical hardware and software to be tested with ground radio-telescopes for potential searching of the microwave region for possible radio signals.

Life Sciences Program

Question: Your budget justification notes that "the Life Sciences program is the key to developing the capability to sustain a permanent manned presence in space and to utilize the space environment to study living systems." Based on the key role that you have assigned to the Life Sciences program and its potential importance to the Space Station program, why are you requesting an increase of less than eight percent over your original FY 1984 budget?

Answer: The Life Sciences Program includes an established, long-standing program of research on the basic biomedical problems of long-duration space flight, which provides an appropriate scientific base for Space Station planning. We expect that additional work specifically related to requirements of the Space Station will be conducted by the Life Sciences disciplines; however, these funds are included in the specific Space Station funded activities.

Question: What was your original request to OMB for the Life Sciences program in FY 1985?

Answer: The FY 1985 OMB Life Sciences program request was $70.0 million.

Question: One of the activities identified for FY 1985 is an interdisciplinary approach to determine how to enhance the capabilities, performance and efficiency of space flight crews. This activity is briefly described on Page RD 4-8 of your budget justification. Could you please provide a more detailed description of the types of activities and specific projects that will be undertaken during FY 1985 in this program area?

Answer: The work on enhancing the capabilities, performance and efficiency of space flight crews that we propose for FY 1985 is organized according to the following categories:

Medical Systems, including capabilities to maintain the health of crews in flight and provide treatment of any illness or injuries that may occur.

Environmental Factors, focused on defining the requirements that must be met for a healthy environment in the spacecraft and developing means to monitor the environment and control toxic and/or microbiological contamination during long flights.

Spacecraft Habitability, which includes provisions for food systems, waste management, personal hygiene, clothing, and the design of crew quarters.

Human Capabilities, aimed at assessing human physical and cognitive capabilities and ensuring that subsystem designs and operational plans make optimum use of both.

Work in all four of these areas is essential to ensure that future space flight crews will work under conditions in which they are able to deliver the best performance of which they are capable.

Question: Could you please indicate the level of funding that will be available for each of these activities during FY 1985 and how they compare to your FY 1984 activity levels?

Answer: The FY 1984 and FY 1985 planned funding levels for the activities referenced above are as follows:

	($in millions)	
	FY 1984	FY 1985
Environmental Factors	0.2	0.2
Medical Systems	4.0	4.0
Spacecraft Habitability	0.5	0.5
Human Capabilities	0.7	0.7
TOTALS	5.4	5.4

Operational Medicine in Space Biology

Question: The goals of your Operational Medicine and Biological Research programs are to assure the health of our astronauts and payload specialists and to assure their ability to function effectively in space environment. The experience gained from these medical studies will provide the necessary information to allow a broader segment of the population to participate in all aspects of future space missions and extend the time that can be spent in space without detrimental effects. To date, about half of our Space Shuttle astronauts have experienced some form of "space sickness." This is a larger portion than was experienced in previous manned flight missions. What specific activities are you undertaking during FY 1985 in order to counteract these space effects?

Answer: Under the direction of the newly established Space Biomedical Research Institute at the Johnson Space Center, studies are planned to try to better understand and prevent the undesirable effects of the Space Adaptation Syndrome. For example, pharmacological investigations will be conducted on the ground and inflight on such drugs as astemizol, metacolpromide, scopolamine, dexadrine and certain neuropeptides. Additional work will be performed on autogenic feedback and upon other psychological preventive or therapeutic techniques. Additional effort will be placed in identifying suitable procedures for preadapting crews to spaceflight. This work will focus on the use of electrophysiologic and physical procedures such as galvanic vestibular stimulation and the physical loading of the head, neck and torso. In order to uncover better predictive strategies, measurements will be made of chronic stimuli and correlated with the subsequent occurrence of motion sickness. A search will be undertaken for biochemical correlates of motion sickness as well as further correlates which depend on the measurement of vestibular function. Particular attention will be paid to determining whether unusual dynamic visual scenes are predictive of motion sickness, and correlations will also be sought in answers to specific questions designed to probe the individuals ability to cope with unusual visual and vestibular stimuli. In terms of more basic research, attempts will be made to characterize otolith and canalicular function of the ear, both on the ground and in spaceflight. Gastrointestinal function will be studied and objective measures of its activity will be developed. In addition, more sophisticated methods of measuring performance will be pursued and applied in space and on the ground.

Question: Would you expect that the frequency and severity of space sickness would increase in the Space Station or space platform environment or have we sufficiently defined the problem to develop countermeasures?

Answer: For the most part, space sickness occurs in the first three or four days of space flight and is considered to be an acute adaptive response to weightlessness. Beyond the first three or four days, all signs and symptoms of space sickness disappear and the crew members can go about their tasks with little concern about any subsequent recurrence of these effects. On Space Station, an almost identical course of events is predicted with the additional advantage that the period of adaptation will represent a much smaller proportion of the overall length of the space mission.

To date the problem of space sickness has not been sufficiently defined that completely effective countermeasures can be developed. Research continues on the ground and onboard the Shuttle to characterize the space adaptation syndrome and to test various promising preventive or therapeutic techniques.

Question: Please provide, for the record, the specific studies, and dollar amounts, associated with your Operational Medicine and Biological Research programs during FY 1985.

Answer: The following is a listing of the planned FY 1985 operational medicine and biological research studies and the associated funding currently planned in FY 1985:

	Approximate Funding Level
Crew Health	1.5M
Longitudinal	.4
Medical Care	.7
Space Adaptation Syndrome	2.3
Environment	.5
Cardiovascular	2.3
Endocrinology	.7
Neurophysiology	2.1
Bone	1.6
Muscle	.9
Psychology	.9
Radiobiology	1.1
TOTAL	$15.0 million

Venus Radar Mapper

Question: This year you are requesting $92.5 million for the Venus Radar Mapper Mission. Your budget justification indicates that the funds for this mission have been reallocated during FY 1984 to place a greater emphasis on the spacecraft and the experiments, with reduced funding for the ground operations portion of the experiment. This year you are requesting $2.2 million for the ground operation of the program. What was your expected level of support for the ground operations of the program during FY 1985 at the time that your FY 1984 budget was submitted?

Answer: The planned level of support for the Venus Radar Mapper Mission (VRM) ground operations during FY 1985 was estimated at approximately $11 million at the time our FY 1984 budget was submitted.

It should be noted that this amount included a reserve of $5 million because of uncertainties at that time. Since the FY 1984 budget was prepared, we have further defined the mission operations requirements. Also, we have negotiated contracts with our two major contractors. The ground operations activities planned in FY 1985 are now much better defined; thus the reduced level of funding.

Question: What is your most current schedule and cost for this mission through April, 1988?

Answer: The Venus Radar Mapper Mission is scheduled for launch in 1988; the total estimated cost for this mission is $350-$400 million, which has not changed from last year.

Mars Geoscience/Climatology Orbiter

Question: This year you are requesting $16 million for a new start in your Planetary Exploration program. This is the Mars Geoscience/Climatology Orbiter. The description of this program, in your budget justification, states that this mission is a relative low-cost, high-inheritance, modified production line spacecraft that will have a well defined and focus science objective. Obviously, this type of description indicates that the spacecraft has a limited capability. In terms of level of sophistication and the scientific pay-off of this mission, what would be the next level of sophistication that could be added to this mission and what would be the cost of that augmentation?

Answer: The Mars Geoscience/Climatology Orbiter (MGCO) science objectives can be satisfactorily met without the need for a complex, highly adaptive, high-data-rate spacecraft of the Voyager-Galileo class. The principal science need requires state-of-the-art instruments which are being developed for use on this systematic mapping mission and does not require adaptive operations.

The next level of sophistication for a Mars Orbiter mission would be one involving two spacecraft in two different orbits, one undertaking the geoscience/climatology objectives of the MGCO mission and the other undertaking aeronomy objectives (recommended for a later Observer mission in the SSEC core program). Such an additional spacecraft would require a new and different science payload; estimated additional cost for the spacecraft and instrumentation is on the order of $150 million.

No requirement for a sophisticated Voyager-Galileo class spacecraft in Mars orbit has been identified to date.

Question: You note that the planning estimates for the total cost of the development and mission operations is in the $300-$375 million range. At what point, in terms of cost, would this mission, with its limited objectives, no longer be financially justified?

Answer: The total cost of the Mars Geoscience/ Climatology Orbiting (MGCO), developed as a stand-alone mission, is estimated to cost in the $300-375 million range. The budget request will support a mission that we believe is scientifically and technically justified, and if planetary missions can continue to be conducted along the lines of the SSEC recommendations (explorer-class missions), we expect to be able to conduct high quality scientific missions at relatively low costs. The MGCO mission has a sound scientific objective. It is consistent with the trust toward lower cost planetary missions as recommended by the SSEC.

Question: One of your new initiatives this year is the Mars Geoscience/Climatology Orbiter which is planned for launch in 1990. This was the first mission recommended by the Solar System Exploration Committee. Does the initiation of this mission imply that NASA will follow the Committees plan for future missions as well?

Answer: The Solar System Exploration Committee (SSEC) has recommended a core set of solar system missions that will provide a balanced program of planetary exploration of the inner planets and primitive bodies through the year 2000. Following the Mars Geoscience/Climatology Orbiter mission, the SSEC recommended the Comet Rendezvous/Asteroid Flyby mission. NASA does plan to follow the SSEC recommendations.

Mission Operations and Data Analysis

Question: This year, you are requesting $29.4 million for your Mission Operations and Data Analysis activity within your Planetary Exploration program. This represents an increase of $10.3 million over your current operating plan level. What is the basis for this increase?

Answer: The planned $10.3 million increase is needed for the upcoming Voyager Encounter with Uranus in January, 1986. The FY 1985 pre-encounter phase which will continue into FY 1986 is much more active than the cruise operations of FY 1984. The FY 1985 increase is required for the following: organizing and training the operations and engineering teams who will be responsible for controlling the spacecraft during the critical encounter phase, and forming fully staffed science teams to interact with the operations team and analyzing the science data from the encounter.

Question: What will be the costs associated with the Voyager extended mission during FY 1986 of the outyears?

Answer: The planned FY 1986 funding for Extended Voyager Operations is approximately the same level as FY 1985 which is required for coverage of the encounter with Uranus. However, our current plans assume that the outyears will be relatively low (approximately $5 million) in support of Voyager Extended Operations, as the spacecraft will be on its way out to Neptune and requires little ground support. The majority of the $5 million will be utilized for data analysis activities.

Question: How do you explain the increase in Planetary Flight Support from the $17.9 million in your FY 1984 operating plan to the $22.4 million proposed in your FY 1985 budget request?

Answer: The increase in Planetary Flight Support in FY 1985 over FY 1984 is required to upgrade and streamline the space flight operations center at JPL to operate the Voyager, Galileo, ISPM, and VRM missions simultaneously; and, subsequently, the missions of the SSEC-recommended program. Many of the current planetary flight support facilities and much of the associated equipment were originally put in place at JPL to support the Viking missions of a decade ago. To improve productivity, NASA plans to transition to a multi-mission operating approach which avoids duplication of efforts, consolidates functions, and effects modernizations where needed.

Mission Operation and Data Costs

Question: Please prepare, for the record, a total of all funds requested in FY 1985 for Mission Operations and Data Analysis activities associated with missions that will not fly before October 1, 1985.

Answer: The only Space Science and Applications Mission Operations and Data Analysis funding requested in FY 1985 that is associated with missions that will not fly before October 1, 1985, are those requested for the Space Telescope operations and maintenance/refurbishment. The requested FY 1985 funds are as follows:

	($ in millions) FY 1985
Space Telescope Operations	49.0
Space Telescope Maintenance and Refurbishment	25.7

Crustal Dynamics

Question: During FY 1984, you requested $17.5 million for your Crustal Dynamics project. In FY 1985, you are requesting $18.7 million for this project. What will be accomplished at the $18.7 million level that would not be accomplished if you maintained the program at the $17.5 million level during FY 1985?

Answer: The Crustal Dynamics project is measuring and analyzing global tectonic plate motion and plate deformation, regional deformation at active plate boundaries, and earth rotational dynamics using space techniques. These studies are important to understanding fundamental solid earth processes and their relationships to crustal hazards.

In FY 1984, plate motion measurements are being obtained in cooperation with countries in Europe and with Japan, Australia, and Chile. Regional deformation measurements in the Western United States are being continued and extended to Alaska, Canada, and Mexico. The North American studies are providing information on the crustal deformation associated with the San Andreas Fault System, the spreading of the Gulf of California, and the internal stability of the North American Plate. The detection of crustal motion and deformation, which amounts to rates of a few centimeters per year, requires repetitive measurements over a period of years to assure the accuracy of the measurements and to observe changes in rate. The additional funding requested in FY 1985 over FY 1984 primarily provides for the addition of the measurement of South American Plate motion through cooperative programs with Brazil and Ecuador.

Research and Analysis/Remote Sensing

Question: This year you are requesting $1 million for remote sensing under your Research and Analysis activity within your Solid State Observations program.

What do you specifically intend to accomplish with this $1 million during FY 1985 and what are the potential outyears cost for this program?

Answer: The FY 1985 funding requested for remote sensing Research and Analysis will primarily be utilized to develop techniques and procedures to utilize existing instruments, in this case the Landsat Thematic Mapper, to identify major cover classes from image data and to characterize these classes by measuring differences in class characteristics, e.g., leaf area index in forest canopies. The outyear funding levels will be determined relative to what progress is made in FY 1985.

Scatterometer

Question: This year you are requesting $15 million within your Environmental Observations program for the design and development activities of a Scatterometer. And it is expected that this device will be flown on the Navy Remote Ocean Sensing System (N-ROSS) in late 1988 to acquire global ocean data. Could you please provide, the for record, the agreement that NASA has executed with the Navy on this device?

Answer: NASA has made an agreement with the Navy to develop a Scatterometer sensor which is required to meet the Navy Remote Ocean Sensing System (N-ROSS) mission objectives. NASA will be responsible for funding and developing the Scatterometer sensor and Navy will be responsible for funding and developing the N-ROSS spacecraft and launch services. NASA and the Navy will share the acquired data.

Question: Will all the data from this Scatterometer device be made available to the general scientific community--will any of it be classified?

Answer: The Scatterometer data will be made available to research investigators selected via an Announcement of Opportunity (AO), who will have exclusive rights to the data for a period not-to-exceed one year, during which time they will be expected to analyze the data and publish the results. After that period, the data will be made available to the general scientific community.

Origins of Plasma in Earth's Neighborhood (OPEN)

Question: During consideration of your FY 1984 appropriations bill, the Congress included an additional $1 million to enhance the definitional activities of your OPEN mission. What additional activities have you undertaken in FY 1984 relative to this program?

Answer: During 1983, the OPEN program was restructured to include international participation by Japan and the European Space Agency and is now known as the International Solar-Terrestrial Physics (ISTP) program. The potential scientific return has been significantly enhanced while the cost to the United States has remained substantially the same. The additional FY 1984 funds have allowed NASA to accelerate the definition of the instrumentation; thus, allowing ISTP to be considered as a potential FY 1986; new start whereas, OPEN was previously being considered as a potential FY 1987 new start.

Question: Your FY 1985 budget contains a request for $1.9 million for this activity, this represents a decrease of $900,000 from the FY 1984 operating plan level. What was your original request to OMB for this program? What would be the programmatic impact if another million dollars was added to this program in FY 1985?

Answer: The NASA FY 1985 OMB request for Space Physics Advanced Technology Development, which was predominantly for ISTP ATD (previously OPEN), was $1.9 million. This was consistent with planning for a potential FY 1987 new start. Encouraged by the ESA and Japan joint involvement, ISTP is presently under consideration as a potential FY 1986 new start. Additional funds in FY 1985 could be used to accelerate the definition of U.S. spacecraft, instruments, ground system, and the support required to accommodate the ESA and Japanese involvement.

Question: What are the outyear projections for the OPEN program?

Answer: Our preliminary estimate for the ISTP program (previously known as OPEN) is on the order of $400-$600 million (1985 dollars) assuming a 1987/1988 new start.

Earth Radiation Budget Experiment

Question: In your FY 1984 budget, you requested $8.15 million for Mission Operations and Data Analysis on your Earth Radiation Budget Experiment. In your FY 1984 operating plan, you reduced that amount to $7 million. To what extent was Operations and Data

Analysis being used as a reserve account for this program?

Answer: The FY 1984 funding level planned for Mission Operations and Data Analysis decrease was required in order to cover increases in the spacecraft and instrument costs, and with the rescheduling of the NOAA-F launch, we were able to rephase some Mission Operations and Data Analysis activities accordingly. The Mission Operations and Data Analysis funding was not a reserve account; however, we must make trade-offs between the project elements from time-to-time to make the most efficient and effective use of available resources.

Question: What specifically will not be accomplished in FY 1984 as a result of this reallocation of funds?

Answer: Some science team activities which had been planned in FY 1984 have now been rephased into FY 1985 consistent with the rescheduled NOAA-F launch.

Question: Why was this reallocation necessary and what impact will the increases in instrument and spacecraft cost have on the total cost of the program and the schedule?

Answer: As explained above, the reallocation within the requested FY 1984 funding for the Earth Radiation Budget Experiment (ERBE) was necessary to cover increased costs for the spacecraft and instrument development activities; however, we do not expect this reallocation to change our estimated runout cost for ERBE of $110-$130 million.

Environmental Observations Program

Question: In your Environmental Observations program, during FY 1985, you intend to conduct a series of in situ observations to verify the quality of remote observations and prove your ability to interpret them. Could you please describe the types of in situ observations that you intend to undertake and the cost of these observations, the cost of those observations during FY 1985 and the programs for which those observations are supporting?

Answer: Many of the research disciplines in the Environmental Observations program will be conducted in situ observations during FY 1985 to verify the quality of remote observations and to develop and refine our ability to interpret remotely sensed information accurately. A brief description of the plans follows:

In the upper atmosphere program, balloon and rocket borne measurements of ozone and solar flux will be collected to compare with the remote observations from Solar Mesosphere Explorer and Nimbus-7 data. In addition comparisons of balloon borne in situ sensors to test photochemical models of stratospheric processes will be conducted. In situ balloon measurements will also be made for comparison with data collected by ATMOS on upcoming Shuttle flights.

In the mesoscale program, Doppler lidar wind measurements of flow around developing storm systems and in mountain waves will be made from the Convair 990 aircraft. These data will be compared with balloonsondes and Doppler radar measurements.

An ongoing activity in the global-scale program to measure in situ stratospheric temperatures with rocketsondes to compare with the NOAA series of satellite sounders will be continued. In addition, dropsondes and balloonsondes to calibrate airborne remote passive microwave sensors which measure temperature, moisture, and precipitation will be continued as will ground-based radar measurements of precipitation to characterize the radiative properties of precipitation for modeling purposes.

In the oceans program, airborne radars, and shipboard measurements of backscatter, surface stress, wave height, etc., will be made to support the Scatterometer development for N-ROSS. collection of optical and biological data using photometers and spectrometers will be used to calibrate the Coastal Zone Color Scanner on Nimbus-7.

In addition, we carry out a wide range of in-situ measurements for instrument development and specific scientific questions in a number of our programs, i.e., the tropospheric chemistry program to measure specific in-situ chemical radicals, for instance OH and NO_x, and our global weather program to improve active lidar temperature measurements, etc.

The total cost of in situ measurements is currently estimated at $12-$15 million in FY 1985.

Upper Atmosphere Research Satellite

Question: In your opening statement, you say that the Upper Atmosphere Research Satellite is the most significant new initiative in atmospheric science in many years. Could you please expand on that statement, describing why you believe this program was of such scientific importance?

Answer: The Upper Atmosphere Research Satellite (UARS) will be the first satellite ever flown with a synergistic set of remote sensors that can study the chemistry, dynamics, and energy input on a global scale. This region of the atmosphere has been extremely difficult to study because of its inaccessibility relative to the troposphere and thermosphere and because of the high degree of coupling between the complicated chemistry of the region and its dynamics. The region contains most of the atmosphere's ozone which, through its interaction with solar ultraviolet radiation, controls the dynamics of the middle atmosphere with significant impacts on the earth's climate and, perhaps, its weather. The ozone also shields the earth's surface from the carcinogenic effects of solar ultraviolet radiation. The ozone content of the atmosphere is potentially very sensitive to the concentration of man-made chemicals injected into the middle atmosphere from the troposphere. Assessment of these effects depends upon models, in the absence of the data that UARS will provide. UARS will be the first large-scale, space initiative directed toward scientific study of our own planet's atmosphere since ERBE was initiated in 1979. It will introduce a period of vigorous, space-based study of the earth's upper atmosphere comparable to our efforts in studying the atmosphere of our neighboring planets. UARS will address a set of scientific issues with respect to the earth fully as challenging as those we have encountered on other planets. It will also place our models of the middle atmosphere on a firm scientific footing, reduce the wide uncertainty of calculations of man's impact on the middle atmosphere, and allow us to conduct a program of research on the stratosphere to improve scientific understanding of it and our ability to assess potential adverse impacts upon it.

Upper Atmosphere Research Satellite Experiments (UARSE)

Question: Your FY 1984 budget contains $20 million for the Upper Atmosphere Research Satellite Experiments (UARSE) and mission definition. What specific activities do you plan to undertake during FY 1985 relative to the UARSE program?

Answer: Development contracts have been let for the construction of the UARSE instruments, and that work will continue in FY 1985. In the FY 1985 budget, we are requesting a new start for the mission segment of the UARS program which will provide for initiation of design and development activities on the spacecraft, ground data handling facility, and ground operations.

Question: What is the status of the nine experiments that have been selected for the UARSE?

Answer: Development contracts have been let on all of the UARS instruments. All of the instruments will complete definition and actual fabrication will be initiated in FY 1985.

Sub-Orbital Observations

Question: Please provide, for the record, a list of the specific activities that are expected to be undertaken in FY 1984 and those that are expected to be undertaken in FY 1985 in your Sub-Orbital Observations program. Please indicate which activities will be conducted through balloons, which on sounding rockets, and which on high flying aircraft.

Answer: Rockets - In FY 1984, NASA has a total of 46 rocket launches scheduled. As of April 1, 1984, 18 of these have been flown. These rockets support studies in a variety of scientific disciplines. The distribution of FY 1984 is as follows:

- 4 rockets for High Energy Astrophysics Research
- 4 rockets for Galactic Astronomy Research
- 5 rockets for Solar Physics Research
- 4 rockets for Planetary Studies
- 7 rockets for Upper Atmospheric Research
- 21 rockets for Plasma Physics Research
- 1 rocket for Vehicle/Systems Testing

In FY 1985, NASA's current planning assumes a total of 48 rocket launches. The distribution for FY 1985, is as follows:

- 4 rockets for High Energy Astrophysics Research
- 4 rockets for Galactic Astronomy Research
- 4 rockets for Solar Physics Research
- 5 rockets for Planetary Studies
- 7 rockets for Upper Atmospheric Research
- 24 rockets for Plasma Physics Research

Balloons - In FY 1984, NASA has 62 balloon launches scheduled. As of April 1, 1984, 17 balloons have been flown with an 88 percent success rate. These balloons serve a variety of scientific disciplines.

The distribution for FY 1984, is as follows:

- 19 balloons for High Energy Astrophysics Research
- 7 balloons for Galactic Astronomy Research
- 1 balloon for Solar Physics Research
- 28 balloons for Upper Atmospheric Research
- 1 balloon for Plasma Physics Research
- 1 balloon for Vehicle/Systems Test
- 5 balloons for Foreign Reimbursable Flights

In FY 1985, NASA currently plans to conduct approximately 60 balloon flights that will have approximately the same distribution by scientific disciplines as flown in FY 1984.

Shuttle Infrared Telescope Facility

Question: How much is included in your FY 1985 budget request for the Shuttle Infrared Telescope Facility (SIRTF)? When do you intend to undertake a Phase B study on this project? Have you made a determination as to whether this program will be flown as a free-flyer aboard the Shuttle? When will such a determination be made?

Answer: There are no funds specifically identified for SIRTF in FY 1985 at this time. However, we have identified about $500,000 of FY 1984 Physics and Astronomy funds which will be used to sustain the observatory technology studies, and we will continue to define the exact studies and funding required for them over the next several months to see how SIRTF fits within our overall priorities. At that time, a specific amount of FY 1985 funding will be assigned to SIRTF, and our best estimate currently is that we will fund SIRTF at the $1-$2 million level in FY 1985.

The success of the IRAS has demonstrated the scientific need for SIRTF and the technologies of long-lived dewars and superfluid helium management in zero gravity. Discovery of the glow surrounding the Shuttle in the relative low-orbit has also produced new information pertinent to infrared astronomy. These new data have caused us to reexamine the implementation mode for SIRTF; therefore, we are reviewing various potential SIRTF options two of which include free-flyer mode and a Shuttle attached payload mode. As a consequence of this reexamination, we are not prepared to initiate full-scale Phase B studies in FY 1985. We should, however, be in a position to select the implementation mode of SIRTF later this year. We estimate that approximately $20 million will be required over a two- to three-year period to conduct Phase B observatory and instrument definition studies.

The earliest we currently believe we could undertake Phase B studies is FY 1986.

Gravity Probe-B

Question: Could you please describe the activities that you intend to undertake during FY 1985 relative to the Gravity Probe-B experiment and the expected level of effort?

Answer: FY 1985 Gravity Probe-B (GP-B) activities will be directed toward preparation and program planning for a future Shuttle test flight of the GP-B instrumentation for engineering purposes and preparation for a future science mission.

Question: Are you currently considering a flight test of some of the Gravity Probe-B hardware on the Shuttle? How much would such a flight test cost, when would it be scheduled and what benefits might be derived from such a test?

Answer: A Gravity Probe-B Shuttle test flight would demonstrate the ability to integrate several difficult technologies into the instrument for a future GP-B science mission. Cost estimates for this engineering test are under review, but we currently anticipate the flight test instrumentation will cost on the order of $70-$80 million.

Question: Could you please provide a description of the program including a suggested schedule and your latest cost estimate?

Answer: If we conduct a successful Shuttle flight test in the 1988/1989 timeframe, the science mission launch could be flown in 1991 at the earliest. Cost estimates are under review and subject to change as Phase B studies progress. The current estimates are in the $250-$350 million range.

Materials Processing In Space

Question: Last year, you requested $21.6 million for your Materials Processing in Space program. As a result of a Congressional add-on, the program was increased to $23.6 million in your FY 1984 operating plan. For FY 1985, you are requesting $23 million for your Materials Processing in Space program. What was your original request to OMB for this program?

Answer: The FY 1985 request to OMB for Materials Processing in Space was $27.5 million.

Question: Given the importance that NASA has placed on Materials Processing as a reason for space commercialization and the Space Station, why has this program not been increased accordingly?

Answer: During the past year, the Office of Space Science and Applications has taken steps to reorganize and strengthen the management and role of the Materials Processing disciplines to take full advantage of the operational Space Shuttle. However, the program is still in an embryonic stage. Therefore, in addition to reassessing the research and analysis portion of the program, emphasis is being placed on the construction of small, relatively low-cost instruments to provide more flight opportunities to the microgravity science community. In addition, Space Station requirements and definition will evolve from these activities. The FY 1985 budget request is sufficient to allow us to do this in an orderly way.

Question: I notice in the description of the activities to be undertaken in this program area no mention of the use of increased automation. What role do you see for the increased use of automation in your Materials Processing program?

Answer: The Materials Processing program is still in its embryonic stage. We have found that we are in a time where we must frequently manipulate and change experiment protocol. Currently, this is more easily and cheaply done on the Space Shuttle by the crew. As we understand more about processes, we will certainly move to more automation. The McDonnell Douglas experience involving crew-operated and maintained equipment in the Shuttle mid-deck will subsequently move to the orbiter bay and the next step will involve developing a free-flyer. This is a specific example of the evolution we believe will occur in this program.

Question: What resources do you intend to devote to the issue of increased automation for Materials Processing for FY 1985?

Answer: We do expect automation to become necessary within the next 3-5 years. Our current plans assume that we will devote no funding to increasing automated systems.

Question: Do you intend to establish any Materials Processing Centers during FY 1984, and if so, what will be the nature of these centers and NASA's commitment to them over the next several years?

Answer: We are moving to establish one or more Materials Processing Centers in FY 1984 in the area of separation techniques and pharmaceutical research, commonly called bioprocessing. The Center(s) are expected to become the focus of our program in space processing by enlisting the talents of Government and university researchers and involving industrial research.

NASA will commit support to the selected Center(s) for an agreed upon amount of money ($300,000-$400,000 per Center per year) for a minimum of three years following the award. Additionally, we will support the Center(s) by making our unique research facilities, e.g., drop tubes and laboratory equipment, available to Center researchers.

Advanced Communications Technology Satellite

Question: What can be accomplished with the $40 million added to the ACTS program by the House Authorization Committee? How does this change the nature of the program from that proposed by the Administration in your FY 1985 budget request?

Answer: The proposed NASA restructured ACTS program eliminated the flight program and now includes only technology development and ground testing. The additional $40 million was authorized by the House Authorization Committee to perform the original ACTS flight program.

Search and Rescue

Question: What advanced communications technology programs are currently underway at NASA and what is the level of support for these programs? How does this compare to the level of effort maintained during the early 70's by NASA?

Answer: NASA has requested $20.6 million for Communications in FY 1985 of which $2.4 million is Search and Rescue activities; therefore, NASA plans to fund communications technology activities at about the $18 million level including $5 million specifically for ACTS in FY 1985. Specifically, NASA is developing hardware for critical technology elements required for future communication satellites such as:

- proving capability to perform in a system (1) the multibeam antenna, (2) the Baseband processor, (3) the Intermediate frequency switch matrix;
- a complete end-to-end communication system test will be conducted to verify that the advanced system synchronization and user access is feasible;
- the ACTS ground test program will provide a first estimate of the communications quality, reliability and availability.

In the early 70's our budget included funding for development of the Cooperative Applications Satellite which was a joint U.S./Canada program to flight test advanced communications technologies; and development of the Applications Technology Satellites. Once those developments were completed, the technology effort was about $11-12 million, roughly comparable to the FY 1985 request when adjusted for inflation.

Question: In describing your Search and Rescue program, you note that the operational system for the 1990's will be based on a 406 MH_z system. Have the Canadian, French, Norweigan, United Kingdom, and USSR. governments agreed to participate in this operational system and agreed on the characteristics of the system to date?

Answer: All Search and Rescue participating countries have agreed on the 406 MHz system. The demonstration of the improved effectiveness of the 406 MHz system has been an integral element of the present Search and Rescue activities. Therefore, all of the satellites presently in orbit and those planned for launch in the future will carry the 406 MHz processors. Similarly, the ground stations are equipped to handle the 406 MHz data. There are currently only two elements not fully agreed upon: (1) the international adoption of uniform technical standards, and low-cost, commercially available, distress transmitters for aircraft and boats which meet those standards. All nations participating in COSPAS/SARSAT are cooperating in the appropriate international bodies to obtain adoption of these standards. A great deal of progress has already been made both in the development of the standards and in the design of cost effective distress transmitters.

Canadian Arctic Mapping

Question: Last year, I questioned you about the Canadian government's recently proposed program to map the Arctic icefields on a continuing basis. What is the current status of this mission and your conclusions about American participation?

Answer: It is our understanding that Canada plans to launch a Synthetic Aperture Radar (SAR) into near-polar orbit in the 1990/1991 timeframe, primarily to monitor Arctic sea ice for operational purposes. Phase B funding for the mission has been approved to cover both this activity and closely related Canadian involvement in the European Space Agency's ERS-1 satellite (ERS-1 will also carry a SAR, and is planned for launch in 1988/1989).

NASA has been asked by the Canadians to consider participation by providing a Scatterometer sensor for the measurement of sea-surface winds and possibly a Shuttle launch. This would provide continuity with results from a Scatterometer aboard N-ROSS. NASA involvement in this program would enable us to meet continuing Scatterometer-related research needs. It would also permit us to have a significant voice in the operation of the SAR aboard the Canadian satellite (Radarsat) to obtain coverage of desired sea ice and land areas within view of our Alaska ground station, thus enabling us to meet SAR-related research needs. (This Alaskan station would also be used to receive data from the ERS-1 SAR noted above.) NASA's potential involvement in the Radarsat program is still under consideration.

Acid Rain

Question: To what extent will your environmental observations program be of value in detecting the circulation and fate of nitrous oxide and sulpher oxide clouds associated with acid rain?

Answer: NASA is a member of the Federal acid rain task force and of two of its subgroups regarding atmospheric processes and natural sources and sinks. In the past, NASA has participated in joint projects with the Environmental Protection Agency where we have flown several remote and in-situ sensors aboard aircraft and tethered balloons to determine ozone and aerosol vertical profiles on a regional scale. We have also conducted studies of GOES satellite imagery to study the growth and transport of polluted air masses across large distances. These studies have shed considerable light on the long-range transport issue that is a central part of the acid rain problem. In addition, much of the instrument development and clean air troposphere measurements undertaken as a part of the upper atmosphere research and analysis program to assess tropospheric sources and sinks for the stratosphere and mesosphere will produce data related to the ultimate understanding of the acid rain question and help define instruments that should be useful in future field studies associated with the acid rain question. Although the instruments required for our studies generally have sensitivities greater than those defined for many current acid rain studies, we routinely report on this work to the task force through the two research subgroups.

Question: How much are you requesting for NASA programs that could directly contribute to our understanding of the acid rain?

Answer: We estimate the value of this tangentially related work in FY 1984 to be approximately $3 million and plan to fund efforts in FY 1985 at about the same level.

National Academy of Sciences Review Committee

Question: How much have you earmarked in your FY 1985 budget for special studies to be carried out by the National Academy of Sciences and Engineering Through the mechanism established by the Congressional Appropriations Committees several years ago?

Answer: NASA has earmarked $200,000 in FY 1985.

Subsonic Wind Tunnel Accident

Question: On December 9, 1982, an accident occurred in the 80x120 foot leg of the Ames Subsonic Wind Tunnel. On February 2, you informed us that you had exercised your authority to make emergency repairs. How much money has been transferred from your Construction of Facilities (CofF) account for this purpose?

Answer: The total $26.5 million that has been approved for emergency repairs is from the CofF account.

Question: What CofF projects will be impacted and to what extend?

Answer: The Ames Research Center FY 1982 discrete project, "Modification of 12-foot Pressure Wind Tunnel," funded at $18.5 million, has been canceled and the entire appropriation is being used for the emergency repairs. It is NASA's intent that the 12-foot Pressure Wind Tunnel project will be considered for inclusion in a future CofF budget. The project will compete for budget status along with other projects at that time. The remaining $8.0 million was drawn from residuals to projects authorized and appropriated in over a decade of NASA CofF programs (FY 1982 and prior).

Question: What was your original estimate for the repair of this facility?

Answer: The original cost estimate which was based on the readily visible and identifiable repairs and replacement of damaged components was $11,650,000.

Question: Please bring us up-to-date on the status and expected costs of the wind tunnel repairs. How much of the expected costs would you characterize as re-design (e.g., new wind deflection vanes) and how much repair (e.g., new fan blades)?

Answer: The current repair estimate to provide full operational capability is $26,500,000. It is estimated that approximately $16.0 million will be used for direct repairs and replacement. Approximately $10.5 million will be used for redesign and replacement of major structural inadequacies, strengthening, and correcting airflow deficiencies required to return the tunnel to a safe, full operational mode as originally intended.

Wind Tunnel Testing

Question: Please indicate the total amount contained in your FY 1984 budget for wind tunnel testing during FY 1985.

Answer: The FY 1984 budget contained no funds for wind tunnel testing during FY 1985; any carry-over of funds from FY 1984 to FY 1985 is negligible. The FY 1985 budget contains approximately $70 million for wind tunnel operations at the Ames, Langley, and Lewis Research Centers. Of this, $30 million for civil service compensation and utilities is in the Research and Program Management budget, and $40 mission is in the Research and Development budget.

Question: How much of this testing was planned to be conducted in the 80x120 wind test tunnel that recently was put out of commission? Could these tests be done elsewhere; and, if so, what would be the cost?

Answer: In view of the fact that the 40X80X120-foot wind tunnel drive system will not be available for research operations until FY 1986, the research program has been revised to more fully utilize other facilities at Ames Research Center, such as the 7X10 foot wind tunnel and the Outdoor Aerodynamic Research Facility (OARF), as well as to conduct some tests in the 40X80X120-foot facility with "wind off." (These are static tests which can take advantage of the 40X80X120-foot wind tunnel instrumentation and data acquisition capabilities and controlled test environment.)

Furthermore, a significant effort is continuing to support the repair of the 40X80X120 facility. This effort involves extensive analytical and experimental activities to properly determine the aerodynamic characteristics and proper design of the wind tunnel circuit and its various components.

The uniqueness of the 40X80X120-foot wind tunnel makes it difficult, if not impossible to perform tests designed for it in other facilities. However, tests performed in other NASA facilities instead of the 40X80X120-foot facility would have no noticeable impact on the ongoing level of facility operations cost unless additional personnel or electrical power were required. The chief cost would be the "opportunity cost" of tests not conducted due to preemptive rescheduling of facility time for higher priority projects.

Aeronautics Terminal Configured Vehicle

Question: What activities do you expect to undertake during FY 1985 in your Terminal Configured Vehicle Program? How much have you budgeted for this program in FY 1985?

Answer: The activities of FY 1985 which the Advanced Transport Operating Systems (ATOPS), previously Terminal Configured Vehicle program, will undertake with the $6.3 million which NASA has budgeted for it will contribute to a technology base for more efficient transport aircraft operations and increased terminal area operational efficiency and capacity. This will be done through analysis, simulations, and flight validations in an operational environment directed at: (1) improved aircraft capabilities to define and perform efficient flight paths in a congested terminal area environment in adverse weather conditions and (2) improved accommodation of airborne capabilities by the evolving modernized National Airspace System. Research activities which will be emphasized are flight path optimization in realistic air traffic control environments, flight path performance including 3D/4D conformance and adverse weather accommodations, and air traffic control/aircraft systems integration. Much of the work such as wind shear detection and display, Microwave Landing System applications, integrated flow management, data link applications, runway traction measurements, and runway turnoff/rollout guidance will be done in close cooperation under interagency agreements with the FAA. Although a major portion of the work will be done in-house, the three major U.S. transport aircraft manufacturers and several other contractors will participate thereby expediting technology transfer. Approximately thirty percent of the budget will be devoted to establishing or modernizing research capabilities, such as the Mission Oriented Terminal Area Simulation and the experimental systems concepts in NASA's B-737 research aircraft, and operations at the research airport at NASA's Wallops Flight Facility.

Aeronautical Research and Technology Reimbursable Program

Question: Your FY 1984 budget justification indicated that NASA expects to receive $22.8 million in reimbursements associated with your Aeronautical Research and Technology Program during FY 1983 and $24.3 million in FY 1984. Your FY 1985 justification contains estimates of $40.4 million and $50 million for FY 1983 and FY 1984, respectively. How do you account for this apparent difference?

Answer: The reimbursement increases in FY 1984 and FY 1984 of $17.6 million and $25.7 million, respectively, are due to the NASA/DARPA X-Wing program and several aeronautics programs that were formulated and approved by NASA and the sponsoring agencies during FY 1983, subsequent to the submittal of last year's FY 1984 budget request to Congress. These reimbursable estimates have been updated to reflect these approved programs and have been included in the FY 1985 budget estimates. A comparison of the reimbursable estimates contained in the two budget submissions is shown below, along with a listing of the programs which were not included in the FY 1984 budget submissions.

Aeronautics Reimbursable Program
($ in millions)

	FY 1983	FY 1984
FY 1984 Budget Estimate (Jan. 1983)	22.8	24.3
FY 1985 Budget Estimate (Jan. 1984)	40.4	50.0
Difference	+17.6	+25.7

Explanation of change by program:

	FY 1983	FY 1984
(1) NASA/DARPA - RSRA/X-Wing program	13.0	18.0
(2) DOT - Voice Switching Control Sys	1.5	1.5
(3) Navy - Aerospace Vehicle Design	1.2	2.0
(4) Other	1.9	4.2
DARPA - Forward Swept Wing Prog.	0.0)	(3.8)
DOT - B-720 Crash Test Program	(0.5)	(0.0)
DOT - MLS Airplane Modeling	(0.5)	(0.0)
Navy - XV-15 Support	(0.5)	(0.0)
Small miscellaneous projects	(0.4)	(0.4)
Total	17.6	25.7

Question: What percent of your total Aeronautical Research and Technology Program does the DOD contribution account for in FY 1984? What percent of your FY 1985 Aeronautical Research and Technology Program does this anticipated DOD reimbursement account for during FY 1985?

Answer: Reimbursements from the Department of Defense (DOD) are expected to be approximately $45 million in FY 1984. This amount is equal to about 15 percent of the total Aeronautics direct R&D program in FY 1984. In FY 1985, DOD reimbursements are expected to be approximately 9 percent of the total direct Aeronautics R&D program contained in the FY 1985 budget request.

In FY 1984, 88 percent of the DOD reimbursements support the joint NASA/DARPA X-Wing and Forward Swept Wing programs and the Army low-speed aeronautical activities being carried out at the Ames, Langley and Lewis Research Centers.

DOD/NASA Cost Sharing

Question: Please list all of the FY 1984 and FY 1985 programs in which NASA and the Department of Defense are proceeding with jointly funded technology programs and the DOD cost contribution on each.

Answer: Department of Defense funding for joint aeronautics projects is shown below. The total DOD cost contributions are not readily available because

DOD not only provides funding but it also supplies aircraft, engines, logistical support (spares and parts) and manpower to these programs.

NASA/DOD Jointly Funded Aeronautics Technology Programs
($ in millions)

	Estimated DOD Funding FY 1984	Estimated DOD Funding FY 1985
Research and Technology Base	4.6	4.8
Propulsion Systems Research and Technology	2.5	2.0
Small Engine Component	2.5	2.0
Controls and Guidance Research and Technology	.1	.3
Computer Science and Applications Research and Technology - IPAD	2.0	2.5
Systems Technology Programs	53.1	29.0
Rotorcraft Systems Technology	17.9	13.5
RSRA/X-Wing Rotor	17.7	13.0
Convertible Engine	.2	.5
High-Performance Aircraft Systems Technology	35.1	15.5
AFTI/F-16	10.0	6.4
AFTI/F-111	2.6	1.0
F-14 High Angle of Attack	.3	.3
X-29A Forward Swept Wing	22.2	7.0
F-15 Engine Model Derivative	---	.8
Subsonic Aircraft Systems Technology-Composite Structures Technology	.1	---
TOTAL	57.7	33.8

Small Engine Component Research

Question: During FY 1985, the General Aviation/Commuter Engine Technology effort will continue to serve as a focus for small engine component research. The goal for this program is a 25 percent improvement in small engine fuel efficiency. What specific activities are being undertaken during FY 1984 and FY 1985, and at what level of funding are these being supported?

Answer: The General Aviation/Commuter Engine Technology effort continues to focus on developing design methodologies to minimize adverse size-related effects in small turbine engine components. Specific activities in FY 1984 and 1985 include experimental evaluation of centrifugal compressors that are directly scaled to determine aerodynamic scaling effects, modeling and experimental evaluation of reverse and radial outflow combustors specifically designed for small turbine engines, and modeling and experimental evaluation of radial inflow and axial flow turbines to determine tip clearance and secondary flow effects. The funding levels are:

($ in thousands)

	FY 1984	FY 1985
Compressor	910	900
Combustor	500	600
Turbine	590	600
Total	2000	2100

Question: What specific milestones have been established for this program during FY 1984 and each of the outyears?

Answer: Specific milestones are as follows:

FY 1984

o Complete experimental evaluation of 2 lb/sec centrifugal compressor

FY 1985

o Complete experimental evaluation of 10 lb/sec centrifugal compressor

o Combustor dilution zone code completed

o Complete experimental evaluation of metallic and non-metallic combustor liners

o Complete radial inflow turbine computer codes

FY 1986

- Small engine component facility (CofF) operational
- Complete radial outflow combustor experimental evaluation
- Complete fabrication of cooled radial inflow turbine

FY 1987

- Test cooled radial inflow turbine to determine secondary flow effects

FY 1988

- Evaluation of non-metallic materials for combustor and turbine

FY 1989

- Axial flow turbine blade heat transfer correlations defined

FY 1990

- Initial verification of three dimensional viscous flow models completed for compressor and turbine

Aeronautical Research and Technology/Research and Technology Base

Question: Page RD 12-4 of your budget justification contains a table listing the budget estimates of FY 1985 for your Research and Technology Base Program. Could you please, using the same categories, list the reimbursables expected and the obligations to be incurred during FY 1985?

Answer: The aeronautics reimbursable activities are divided into two categories: (1) Research and Technology Base and (2) Systems Technology programs. The FY 1985 estimates by program category are listed below. It is expected that approximately 80-85 percent of the estimated amounts will be obligated in FY 1985.

Aeronautics Reimbursables
($ in millions)

	FY 1985 ESTIMATES
Research and Technology Base	
Fluid and thermal physics R&T	0.7
Materials and structures R&T	0.6
Controls and guidance R&T	1.9
Human factors R&T	1.6
Multidisciplinary research	0.0
Computer science and applications R&T	2.4
Propulsion systems R&T	4.4
Rotorcraft R&T	4.4
High-performance aircraft R&T	4.3
Subsonic aircraft R&T	0.6
Total Research and Technology Base	20.9
Systems Technology Programs	
Rotorcraft Systems Technology	
RSRA flight research/rotors	0.3
Advanced rotorcraft technology	1.0
Technology for next generation rotorcraft	12.9
High-Performance Aircraft Systems Technology	
High-performance flight research	0.3
Subsonic Aircraft Systems Technology	
Advanced composite structures tech	0.6
Total Systems Technology	15.1
Total Estimated Aeronautics Reimbursable Program	36.0

Aeronautical Research and Technology/Systems Technology Programs

Question: Page RD 12-32 of your budget justification contains a chart displaying your FY 1985 budget estimates for your five System Technology programs. Could you please indicate the amount of your OMB request for each of these system technology programs?

Answer: Our FY 1985 budget request to OMB for the Aeronautics Systems Technology programs is displayed below, along with the FY 1985 Congressional budget request.

	FY 1985 OMB Budget	FY 1985 Congressional Budget
	($ in millions)	
Materials & Struct. Sys. Tech.	2.0	-
Ceramics for Turbine Engines	2.0	-
Rotorcraft Systems Technology	31.7	26.5
Guidance and Navigation	1.7	-
RSRA Flight Research/Rotors	3.5	-
Advanced Rotorcraft Tech.	10.2	10.2
Tech. for Next Generation Rotorcraft	16.3	16.3
High-Perf. Aircraft Sys. Tech.	21.0	21.0
High-Perf. Flight Research	9.2	9.2
Turbine Engine Hot Section Technology	11.8	11.8
Subsonic Aircraft Sys. Tech.	22.2	19.0
Advanced Composite Structures Technology	22.2	19.0
Advanced Prop. Sys. Tech.	48.0	16.1
Advanced Turboprop Sys.	15.9	14.0
Advanced Turboprop (Phase III)	25.0	-
General Aviation/Commuter Engine Tech.	2.1	2.1
Small Engine Component Tech.	5.0	-
Numerical Aerodyn. Simulation	26.5	26.5
Systems Technology Total	151.4	109.1

Question: Under your technology for next generation rotorcraft, you are requesting $16.3 million. This is $8.3 million above the FY 1984 level. How much of this program is being funded by DOD?

Answer: In prior years, the DOD has provided $33.4 million toward this program. In FY 1985, the DOD plans to provide $13 million in support of the Technology for next generation rotorcraft program to supplement the NASA funding of $16.3 million.

Question: This year you are requesting $19 million for your Advanced Composite Structures Technology program. This is a $14 million increase over the FY 1984 level. Could you describe the need for this increase and indicate the outyear costs associated with this program?

Answer: The ACST program is a multi-year systems technology program planned to develop the Advanced Composite Technology data base required for the application of composites to transport aircraft wing and fuselage primary structure. Multiple programs will provide structural design technology through comprehensive element tests, and the design, fabrication, and test of straight and swept-wing box sections, and large, curved fuselage panel sections. The $14 million increase designated for FY 1985 is essential to the establishment of structural configurations for the wing and fuselage designs, and the collection of element test data to determine structural performance, environmental effects, and systems interactions at high load levels.

The planned ACST funding runout is as follows:

($ in millions)

FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	TOTAL
5.0	19.0	25.9	28.6	18.6	10.3	107.4

Question: This year you are requesting $14 million for Advanced Turboprop Systems program. What efforts is NASA making to determine the likelihood of user acceptance of this technology once it is proven to be technologically feasible?

Answer: Before the initiation of the Advanced Turboprop (ATP) program in 1976, NASA contracted with United Airlines to explore potential passenger acceptance of the ATP concept. After analyzing over 4000 passenger questionnaire responses, this study concluded that "Though preferring a jet today, passengers would fly an Advanced Turboprop Aircraft having jet equivalent speed, seating comfort and ride quality if they perceived a significant fuel savings attendant with the advanced turboprop." The resurgence of conventional turboprop-powered commuter aircraft since the deregulation of the airline industry is a further indication of user acceptance of turboprop technology. In addition, the major U.S. airframe and propulsion manufacturers have been deeply involved in the NASA ATP program.

NASA program objectives have been established to achieve the 15-30 percent fuel savings while maintaining the jet speeds, cabin noise and vibration levels of modern turbofan-powered aircraft. A series of model tests in wind tunnels, anechoic chambers, and on a JetStar aircraft have confirmed this performance potential. Research is also underway in the areas of acoustic treatment methods and human response to ATP generated noise. These efforts are aimed at ensuring passenger and community acceptance of the ATP concept. Several cabin wall treatments have already been identified that offer great promise of reducing noise transmission without a significant increase in weight. The current NASA supporting technology program is also investigating aerodynamic integration and innovative aircraft installation arrangements to reduce or isolate noise and vibration from the cabin environment.

Question: What are the total outyear costs associated with this program?

Answer: The Advanced Turboprop program is a broad-based NASA research and technology program to develop single- and counter-rotation propeller, drive system, and aircraft technologies for a new generation of fuel-efficient civil and military transport aircraft. The program includes the design, fabrication, ground test, and flight test of a large-scale advanced propeller to evaluate and correlate propeller structural integrity and acoustic characteristics. Neither issue can be adequately addressed in the small-scale model tests that have laid the foundation for this effort. A second major activity is the large-scale, proof-of-concept testing of a unique, counter-rotation Unducted Fan (UDF) propulsion system. The UDF concept provides the 5-8 percent increased fuel savings advantage of counter-rotation while eliminating the need for a high-power gearbox. NASA's FY 1985 budget submittal requests $14.0 million in FY 1985 and subsequent fiscal years for the Advanced Turboprop Systems program.

On March 28, 1984, the House of Representatives approved H.R. 5154, the NASA Authorization for FY 1985. This Bill authorizes $24.0 million for the Advanced Turboprop program and directs that the flight test occur no later than 1987. Assuming an appropriation of $24.0 million in FY 1985 and $14.0 million in each subsequent year, the additional funding required to meet the Congressionally directed 1987 first-flight date and to continue toward a ground test of the UDF concept in 1987 is $28.0, $29.0, and $16.0 million in FY 1986, FY 1987, and FY 1988, respectively.

Aeronautical Research and Technologies/Multidisciplinary Research

Question: During FY 1984, you intend to obligate $3.7 million for your Multidisciplinary Research program. In FY 1985, you are requesting $6.1 million or a 65 percent increase for this program. How much of this increase is associated with supporting grants to historically black colleges and universities?

Answer: Of the $6.1 million requested for the Multidisciplinary Research program in FY 1985, $3 million (or 49 percent) is for support of grants in the science, engineering, and interdisciplinary departments of historically black colleges and universities.

Senator Garn—Continued

Aeronautical Research and Technology

Question: One of the activities that you intend to undertake under your Materials Structures Research and Technology program is research on a high-temperature engine materials. How much did you spend for these programs during FY 1983 and how much do you intent to spend during FY 1984 and FY 1985?

Answer: The funding for research in the high temperature materials area is identified in the table below.

High-Temperature Materials
($ in millions)

FY 1983	4.3
FY 1984	4.9
FY 1985	5.9

Computer Science and Electronics Research and Technology

Question: In your FY 1984 budget, you requested $16,300,000 for your Computer Science and Electronics Research and Technology program. One of the items you intended to demonstrate during 1984 was the replacement of spacecraft controllers by expert systems. In addition, you intended to design an automatic environmental control and life support system for space applications. Several other robotic systems, including robotic vision, were also to be demonstrated during FY 1984. Could you please describe your accomplishments to date in FY 1984 and your most current schedule estimates for these demonstrations?

Answer: Goddard Space Flight Center awarded a one-year contract to Martin Marietta Denver Aerospace in January, 1984, to demonstrate the feasibility of employing expert systems in a spacecraft control center environment. The intent of the investigation is to evaluate the potential for advanced automation technology to perform some of the functions now requiring human spacecraft controllers. To date, Martin Marietta has completed its initial investigations of control center operations and is formulating the proposed demonstration within the control center for the International Sun-Earth Explorer (ISEE) project. The nature of the specific demonstration is being determined during April of 1984 and the demonstration is currently planned for December 1984.

Through a contract awarded in May, 1983, to Honeywell Systems and Research Center by Johnson Space Center, generic automation and generic controller concepts are being developed for the Space Station that will free man from routine duties and allow him to devote his time to productive scientific missions. To date, automation requirements for three application systems (electrical power, environmental control and life support, and guidance, navigation and control) have been developed and a distributed three-level hierarchical data management system architecture has been selected. The feasibility of the generic automation concept was originally planned to be demonstrated by implementing a preprototype controller for an environmental control and life support system (ECLSS). Funding options are currently being explored to enable a demonstration of this controller in 1986.

In robotic vision research, the Jet Propulsion Laboratory (JPL) has completed the conceptual design of a real-time pipelined programmable image feature extraction system incorporating three custom-designed VLSI chips. This device is a key component of a control oriented robot vision system which is scheduled for laboratory demonstration in 1987. The vision system will be capable of providing useful control information identification and tracking of objects over visually cluttered backgrounds, while providing range, location, and orientation information.

In related teleoperator research, the functional design of an advanced distributed microcomputer system for teleoperator control has been completed. Specifications and initial designs for software to support the hand-controlled subsystem and manipulator subsystem have also been completed. The target for this work is the 1986 demonstrated evaluation of computer-controlled manipulators equipped with sensors.

Question: How much are you requesting to continue these activities during FY 1985?

Answer: FY 1985 funding for research and applications for robotics and artificial intelligence is $3.5 million.

Robotics and Automation

Question: Please provide, for the record, a listing of each of the activities in your FY 1985 request targeted at developing robotics and/or new automated systems or processes of a generic character.

Please indicate the budget request for each of these items and the amount requested of OMB for each of these items.

Answer: Activities of a generic nature supporting robotics and automated systems include the following:

	FY 1985 ($ in millions)
Artificial Intelligence Research	1.3
Decision Making	
Information Understanding & Extraction	
Space-borne Symbolic Processor	
Teleoperations and Robotics Research	1.7
Robot Vision	
Teleoperation/Robotics System Simulation	
Teleoperator Supervisory Control	

These activities are contained in the Computer Science and Electronics R&T Base. There was no change from the FY 1985 NASA budget request to OMB.

Space Research and Technology - Materials and Structures Research and Technology

Question: One of the activities you intend to undertake within your Materials and Structures Research and Technology program involves the development and validation of methods for predicting and reducing unwanted vibration and large flexible space structures. Your budget justification indicates that active and passive damping techniques will be developed. Could you please describe how much you intend to devote to this area in FY 1985?

Answer: The funding for control of flexible structures including active and passive damping for FY 1985 is $4.9 million.

Question: Could you please describe what problems you are addressing in sensing and control integration?

Answer: Large space systems such as a large antenna, large reflectors, and platforms, present significant control problems due to unprecedented system size, variable flight configurations, and structural flexibility. These problems are further compounded by increasing system accuracy requirements.

The performance required of advanced space systems can be achieved only if suitable sensor inputs are provided to the control system. One required input for many applications is the three-dimensional location of many points distributed over an extended region of the space structure. NASA is investigating control sensors which make such multiple measurements at precisions and rates high enough for space applications. These sensors will determine the shape and vibrational motion of the large space structure for the purpose of control. It is anticipated that such a sensor will be developed to the level of a field demonstration unit by the end of FY 1987.

Space Research and Technology/Computer Science and Electronics Research and Technology

Question: This year you are requesting $16.2 million for your computer science and electronics research and technology program. This represents an increase of $100,000 over your FY 1984 program level. Your budget justification indicates that during FY 1984 there was a reduction in the de-sensor technology component of this program. Could you please describe the sensor technology activities that will not be undertaken during FY 1984 as a result of this reduction?

Answer: The development of sensor technology for autonomous systems was delayed during FY 1984 as a result of this budget reduction. The proposed FY 1985 increase will accelerate this effort to achieve autonomous system technologies required for the space station.

Question: This year you are requesting $136 million for your Research and Technology base programs. This is in comparison to a $125.4 million in FY 1984. How much do you intend to spend in FY 1984 for automation, robotics, sensing and artificial intelligence type activities, and how much do you intend to spend in FY 1985 for these activities?

Answer: The following shows the breakout for FY 1984 and FY 1985.

Item	FY 1984	FY 1985
	($ in millions)	
Automation Applications	0.1	0.1
Robotics Research	1.6	1.7
Optical Sensing Research	1.3	1.4
Artificial Intelligence Research	1.4	1.3

Question: On Page RD 13-14 of your budget justification under Computer Science and Electronic and Technology, you note that "robotics research will continue to advance sensing and control technology needs for robotic applications in space." How much do you intend to apply to this area during FY 1985?

Answer: The technology to advance sensing and control technology needs for robotic applications in space are contained in three research elements: robotics, optical sensing, and artificial intelligence. The funding levels for these three areas are delineated in the previous response.

Question: To what extent to you expect to incorporate the findings of these programs into your Space Station project?

Answer: The generic technology covered in the three technology items listed above is directly applicable to the space station project and may be incorporated into the Space Station system as the technology becomes available and as the architecture of the Space Station is defined.

Question: What mechanism has been established within NASA to coordinate the activities of these various automation research functions at the Space Station design and integration level?

Answer: NASA uses two primary mechanisms to coordinate its activities in automation research and technology at the Space Station systems design level. One is the Space Station Technology Steering Committee and its discipline working groups, particularly those dealing with systems operations and data management. Based on Space Station mission definition and requirements, these groups formulate and evaluate programs for technologies with the potential for inclusion in the design of an initial Space Station. A second mechanism is the one that occurs naturally in the conduct of systems level studies. By examining the integration and interaction of subsystems these studies identify the advances in automation technology that are needed thus assuring relevance of the research topics being pursued.

Question: What members of the Space Research and Technology program have been assigned to the Space Station Task Force?

Answer: Two members of the Space Research and Technology Headquarters staff have been temporarily assigned to the Space Station Task Force. One is a technical program manager; the other an administrative assistant.

Space Research and Technology - Platform Systems Research and Technology

Question: The objective of your Platform Systems Research and Technology program is to develop the system level research and technology capabilities which enable future manned and unmanned large space platforms. In your FY 1984 budget submission, you requested $12.1 million for this Systems Research and Technology area. In you FY 1984 operating plan, you reduced this to $8.8 million. Your FY 1985 budget further reduces this to $7.8 million. One of the specific objectives of the program is an emphasis on advanced automation techniques. What advanced automated techniques are being explored under this program?

Answer: Our work in platform systems is directed toward systems level research and technology. System level automation techniques for the Space Station include the development of an automated hierarchical control function that will generate distributed multi-level control commands through distributed processors. The architecture of the automated Space Station will be configured so that conservative closed-loop techniques can be used to automate control functions for the initial Space Station. Advanced "planner and expert systems" artificial intelligence techniques may be added for the growth station as these become available.

Question: Your budget justification states that a definition of the functional requirements needed for an automated unmanned spacecraft have been completed. Could you please describe what functional requirements have been identified and what type of spacecraft you are considering as the basis for this automation?

Answer: The functional requirements that have been identified are in the category of housekeeping and include subsystems such as power, thermal, attitude control, communications, and data. The spacecraft referenced are of the planetary unmanned type similar to Voyager and Galileo.

Question: During FY 1985, the Platform System Research and Technology program is organized into three subprograms. One of these subprograms is involved with the evaluation of automated and autonomous system concepts which could provide an early capability.

Senator Garn—Continued

Another one of these areas involves the experimental investigation of teleoperations and robotics. The third is associated with crew and life support research. How much was devoted to each of these three areas during FY 1984 and how much do you intend to devote to each of these three areas during FY 1985?

Answer: During FY 1984 the funding for these three areas is $3.8, $2.1, and $2.9 million, respectively, for a total of $8.8 million. During FY 1985, we intend to fund these areas at $3.2, $1.7, and $2.9 million for a total of $7.8 million.

Space Research and Technology - Space Shuttle Main Engine

Question: Your FY 1985 budget requests $2.1 million for the utilization of a test bed engine with the purposes of providing data to develop models and validate analytic methods. Such models and methods are expected to be of considerable importance in understanding the characteristics of the Space Shuttle main engine and ultimately increasing the efficiency and durability of the engine. The Subcommittee encourages NASA to continue the development of this SSME technology program. Could you please provide for the record an estimate of the outyear costs associated with this program?

Answer: The Test Bed Engine Technology Program consists of dollars contributed from Space Research and Technology and from the Space Shuttle Main Engine program. The current breakdown of the projected out-year costs as contained in the runout of the FY 1985 Budget request is:

	Space Research Technology ($ in millions)	Space Shuttle Main Engine Program ($ in millions)
FY 1985	2.1	11.3
FY 1986	5.8	19.6
FY 1987	8.1	31.0
FY 1988	9.9	32.0
FY 1989	11.4	34.0

Tracking and Data Relay Satellite System

Question: What would be the effect if the Congress did not approve a cap bust for the entire TDRSS program?

Answer: Several alternatives to increasing the TDRSS cap have been discussed with Subcommittee staff members. They include shortening the service period to remain within the cap; increasing appropriations in the near term to retire Federal Financing Bank (FFB) loans early to reduce interest costs; retiring the total FFB loans with a lump sum payoff in a near term appropriation.

The shortening of the service period would reduce the useful life of the program from ten years to roughly six years. This alternative would reduce the program costs roughly five percent at the expense of a 35-40 percent reduction in service.

Early retiring of FFB loans in whole or in part would reduce total program costs but require sizable increases to projected TDRSS budget levels in near term fiscal years to effect the interest savings required to remain within the current cap. Early retirement of the loans would have no other substantive effect on the program.

Inertial Upper Stages (IUS)

Question: Four IUS vehicles have been procured for launch of the initial four Tracking and Data Relay Satellite System spacecraft. The first of these three IUS's were funded by the TDRSS. The Fourth spacecraft is funded under your Upper Stages program. Could you please, explain the reason for this split funding of the IUSs?

Answer: At the time the TDRSS Contract was signed, the program was a shared program with commercial as well as governmental service to be provided. In addition, the launches of the first three spacecraft were originally planned to occur prior to the projected operational readiness of the Space Transportation System (STS). Due to these two aspects, the first three launches were planned on conventional vehicles with a later conversion to Shuttle based vehicles, and offerors on the TDRSS contract were instructed to include the first three launch vehicles in their bids. All launches after the first three were to be funded by NASA.

Subsequent changes to the program altered the schedule and the vehicles to be utilized in launching the initial spacecraft, but there was no change to the provisions which required the Contractor to fund the first three launch vehicles via the TDRSS Contract and no provision in the NASA budget to provide funding for these launches.

Question: What are the implications for FFB interest rate cost associated with this funding strategy?

Answer: The interest costs to the TDRSS program are higher because the first three vehicles are provided via the contract. The estimated interest costs for IUS funded via the TDRSS contract are $80 million.

Tracking for Halley's Comet Cost

Question: Last year, I questioned you about the cost involved in providing the Tracking and Data Acquisition Activities for the missions to Halley's Comet by the European Space Agency and the Japanese. What is the current status of this program and your most current estimate of the cost to be born by the United States?

Answer: The ESA activity is proceeding smoothly, with NASA, ESA, and JPL coordinating all data acquisition activity planning and documentation in preparation for the mid-1985 launch of GIOTTO, and the March, 1986, Comet encounter. All costs for the planning, documentation, and actual tracking support are being paid for by ESA on a reimbursable basis.

At this time, NASA has yet to receive a support request for the Japanese Planet-A mission to Halley's Comet. Such a request is expected to include only launch support. No tracking of the Planet-A spacecraft during its near approach to Halley's Comet is expected. Support to Planet-A, if requested, would be provided on a reimbursable basis.

Tracking and Data Acquisition - Communications in Data Systems

Question: Your FY 1984 operating plan contains an estimate of $40.7 million for your data processing operations. This is essentially the same amount as actually experienced in FY 1983 ($39.3 million). For FY 1985, however, you are requesting $50 million for data processing operations. Could you please explain why you feel it is necessary to increase the data processing operations by 23 percent?

Answer: The increase in the data processing operations budget from FY 1984 to FY 1985 of $9.3 million is required for the following reasons:

o Increased workload presented by new missions to be supported during FY 1985 including Spacelabs, ERBS, and build-up for Space Telescope

o Preparation, principally software development, for upcoming approved missions
  -Attached pallet payloads, GRO, UARS, COBE

o Purchase of equipment currently being leased
  -Flight Dynamics System, Support System Processor

o Continue and/or improve data products
  -Nimbus, Landsat

o Escalation

This increase continues to provide support for NASA missions as exemplified by our recent successful development of the Spacelab Data Processing Facility. All data received was delivered to the international and national experimenters within 60 days.

Technology Utilization

Question: This year you are requesting $9.5 million for your Technology Utilization program. This is $500,000 above the FY 1984 level. You note that at this level, NASA will continue its efforts to transfer technology to U.S. industries at a level made possible by the FY 1984 Congressional augmentation. Could you please describe the specific programs and activities that you intend to target for technological transfer during FY 1984 and FY 1985?

Answer: With the augmented FY 1984 budget and the FY 1985 requested budget, NASA will continue to define ways to make the program be more effective and far-reaching. Planned new initiatives include modernization of techniques, a more focused approach with greater private sector involvement, etc. The approach NASA is currently pursuing emphasizes "wholesaling" rather than "retailing" of technology information; and, is described as follows: First, advanced technology dissemination techniques is being used to disperse information through non-profit or state-sponsored industry assistance activities and then to their in-state industrial clientele or other users. Second, NASA is encouraging greater private sector involvement in dissemination of information specifically by converting NASA Tech Briefs, the principal technology announcement mechanism, to a commercial publication, and by encouraging greater private sector participation in technology applications projects. In addition, NASA is focusing the transfer of technology through applications projects in high growth areas, such as materials, electronics and the like.

Question: In describing your technology Dissemination program, you note that NASA will continue to realign and improve this program with particular emphasis on decentralization of information search capabilities and modernization of the communication media. Can you please describe the specific improvements that will be made both in terms of your information search abilities and communications?

Answer: NASA has made significant headway in the past year in developing new techniques for broadening the Technology Dissemination program. New search and communications techniques currently being implemented at the Industrial Applications Centers (IAC's) and State Technology Applications Centers (STAC's) across the the Nation create an opportunity for states to tie-in to NASA's data base in order to make access to this information more readily available to their in-state industries. For example, the NASA-sponsored IAC at the University of Southern California already has commitments from three states, out of a 13 state region, to provide real-time information search capabilities remotely through teleconferencing techniques. Other centers, such as the University of Florida STAC are using remote interactive search systems to provide service linkages with other universities and state institutions throughout their regions. The NASA IAC in Indianapolis, Indiana, to greatly improve search post-processing to heighten user relevance, reduce redundancies and increase productivity in meeting user needs in industry. Such qualitative improvements in the dissemination center network, as those described, will permit broader and increased technology transfer services to industry, particularly the small business sector.

Fire Simulator

Question: I understand that you are currently engaged in an effort to develop a video fire simulator for use by the Federal Emergency Management Agency (FEMA) in training fire fighters. I have heard that FEMA is quite pleased with the results of this project to date and they consider it to have great promise as a training tool. Could you please describe this effort, including cost, and indicate when it will be completed?

Answer: NASA's Marshall Space Flight Center (MSFC), in response to a request from the Huntsville (Alabama) Fire Department, has developed a video fire simulator prototype known as the Emergency Management Computer Aided Training System (EMCAT). The EMCAT enables a trainee to assume the role of fireground commander and make quick decisions as to the best use of his firefighting personnel and equipment.

Watching the fire's progress on the TV screen, the trainee is presented a sequence of decisions on the computer monitor; the trainee's response, tapped out on the keyboard, causes the video fire to change for better or worse. If the trainee makes a series of correct decisions, the fire is extinguished; if the wrong decisions are made, the fire will go out of control. At the end of the exercise, each trainee is critiqued by an instructor.

The EMCAT concept was shown to firefighting authorities from all over the country in demonstrations at MSFC, in Memphis, Tennessee, and in Fresno, California. The highly favorable response led to initiation of a development program to commercialize the EMCAT. The program is a joint undertaking of NASA, the National Fire Academy, and the Federal Emergency Management Agency. A competitive contract for commercialization has been awarded to Essex Corporation, Huntsville, Alabama. Essex Corporation is now in the design phase of an advanced EMCAT system and is working on an initial set of six fire scenarios. The first simulator and at least one new scenario will be ready for test next year. Three production systems are scheduled for delivery in mid-1985.

NASA investment in the EMCAT during FY 1983 and FY 1984 has been approximately $90,000, and FEMA investment has been approximately $130,000. NASA currently has no plans to fund this effort in FY 1985.

ADDENDUM

[CLERK'S NOTE: Enclosures 1 through 4 were provided by NASA to augment responses to Senator Garn's questions.]

ENCLOSURE 1
2/24/84

SPACE STATION
$8.0 BILLION PROGRAM CONTENT*
(1984 $ IN MILLIONS)

DEFINITION STUDIES ($614)	A thoroughly detailed examination of requirements, engineering designs, subsystem advanced development, test beds, and Space Shuttle flight experiments before proceeding with hardware development in FY 1987.

INITIAL SPACE STATION WITH THE FOLLOWING CAPABILITIES:

LABORATORY ($1036)	Provision for research, development and demonstration in a pressurized environment with continuous manned interaction and external attachments to which unpressurized experiments and payloads may be connected.
HABITAT ($1220)	Private crew quarters, a wardroom & a galley to provide for essential health & recreational needs.
RESOURCES ($1855)	Electrical power, thermal control, data processing, communications, attitude control, and orbit maintenance.
MULTIPLE BERTHING ($965)	The coupling unit to which the Space Station modules are connected and in which spacesuits are stored and serviced.
LOGISTICS ($820)	Resupply with required consummable items. Also contains facilities for crew hygiene and material to be returned to the ground.
SERVICING ($420)	Attachment facilities and hangars in which satellites and the Orbital Maneuvering Vehicle will be serviced, refueled, and stored.
PLATFORMS ($730)	Unmanned spacecraft, operated or serviced from the Space Shuttle or Space Station, and which will provide power, thermal control, data transmission, attitude control, and orbit maintenance for a complement of payloads.
SUPPORT SERVICES ($340)	Equipment required to process and launch Space Station elements; control of the Space Station and platforms; customer data interface and crew training.

* $ ESTIMATES BASED ON OCTOBER 1983 ANALYSIS BY THE SSTF CONCEPT DEVELOPMENT GROUP TO ACCOMPLISH THE OBJECTIVES ABOVE. THESE ESTIMATES ARE BASED ON FUNCTIONAL COSTS RATHER THAN ON HARDWARE.

ENCLOSURE 2

SPACE STATION AUTOMATION STUDY
(CONCEPT)

Space Station Philosphy

The Space Station will be developed to function in the most effective and efficient manner possible. This will require the use of the highest degree of automation technology available and applicable to the functions to be accomplished.

Objective

The efficient operation of the Space Station requires an accurate functional analysis to ascertain the maximum automation level possible with any mission set. This analysis will be one input in defining the most effective partitioning of functions between man and automated elements. The primary study objective is to undertake an early focused analysis of the potential of significant advances in automation and robotics technology toward the enhancement of Space Station operations.

Approach

The study itself will be done under contract. However, an advisory panel will be constituted to assist in projecting technology state-of-the-art and potential enhancements of that technology through additional stimulus. The study to be performed will produce data from which NASA will develop a set of automation and robotics goals and guidelines for the definition phase. During the definition phase, an assessment of the potential of these technologies will be performed, which will serve as the foundation for implementation of an appropriate level of effort during Space Station development.

Methodology

The study will determine:

- the level of technology available for the early 1990's in:
  - automation
  - sensors
  - robotics
  - expert systems
  - artifical intelligence
  - telepresence
- the potential of such technology for accomplishing the generic functions associated with Space Station operations such as:
  - assembly
  - servicing satellites
  - conducting life sciences and materials sciences experiments
  - changing experiments and replenishing expendables on unmanned platforms
  - and all other mission functions required for an operational Space Station
- an approach to the definition of an operational Space Station scenario that considers the most effective use of man's inherent capability in space and on the ground in serving as an executive director and overseer; using his innate cognitive capability in conjunction with the automation and/or robotics of the 1990's

- the technological/information processing advancements and/or breakthroughs needed to automate the remaining man-assigned functions which can be automated, and time frames for achieving these advancements

- approaches whereby such an operational scenario might be modified as new technologies in the robotics/automation field become available.

Product

The data from this study will enable NASA, utilizing an automation and robotics panel consisting of members from academia and highly automated industries, to develop the goals for automation and robotics for the definition phase. Assessments of risks and benefits of automation and robotics will be made during the definition phase. These assignments will provide NASA the data to determine appropriate implementation levels for automation/robotics technologies during the development phase.

Contract Conditions

- extramural; university/industry-based

- appropriations staff to be involved in technical meetings with study contractors

- completed within one year of initiation in time to serve as input to definition contracts

February 24, 1984

ENCLOSURE 3

KSC MAJOR FACILITIES FOR THE GALILEO AND ISPM MISSIONS

FACILITY	MODIFICATIONS NECESSARY	READINESS DATE	COSTS*
o SPACECRAFT FLOW:			
PAYLOAD PROCESSING FAC	NONE - (HGR AO, SAEF-2)	EXISTING	
HAZARDOUS PROCESSING FAC	NONE - (ESA 60)	"	
o CENTAUR STAGE FLOW:			
HANGAR J	NONE - (HGR J)	"	
LAUNCH COMPLEX 36A	MODIFY FOR SHUTTLE-TYPE CENTAUR ADD HAZARDOUS GAS DETECTION SYS ADD ENVIRONMENTAL CONTROL SYS	5-15-85	14-16M
o SPACECRAFT/CENTAUR FLOW:			
VERTICAL PROCESSING FAC	MODIFY ELECT SYS AND CARGO I/F PANELS	4-30-85	2M
o SHUTTLE FLOW:			
OPF	ADD NEW CRYO TEST/CHECKOUT SYS	9-30-85	3M
VAB HIGH BAYS	NONE	EXISTING	
MLPs 1 AND 2	MODIFY TSMs FOR LOX, He LOAD ADD VALVE SKIDS FOR LOX LOAD	1-1-86	5M
o SHUTTLE/CENTAUR/SPACECRAFT FLOW:			
LAUNCH COMPLEX 39 PAD B	ACCELERATE READINESS DATE TO ADD ROLLING BEAM UMBILICAL SYS	1-1-86	12M
	ADD VALVE SKIDS FOR LH2 LOAD TEE IN OTHER FLUID SYS		4M
LAUNCH COMPLEX 39 PAD A	ADD ROLLING BEAM UMBILICAL SYS	3-1-86	
	ADD VALVE SKIDS FOR LH2 LOAD TEE IN OTHER FLUID SYS		6M
o CONTROL SYSTEMS/LCC	MODIFY S/W AND SAFING CABLES AND EQUIPMENT	9-30-85	4M

*MODIFICATIONS NOT UNIQUE TO THESE TWO MISSIONS - FOR ALL CENTAUR MISSIONS.

ENCLOSURE 4

Report to the Senate Appropriations Committee on the Selection of Principal Investigators on the Space Telescope

Report #98-152 which accompanied H.R. 3133 of the Department of Housing and Urban Development Independent Agencies Appropriation Bill 1984 had the following request:

> "...the Committee is concerned about the future of the Space Telescope. The Committee expects this facility to be available to the entire astronomy community through a broad based peer review process. The Committee does not intend to sit idly by while the astronomy program is fractionalized. The Committee expects a joint NSF/NASA report on the process that will be used for the selection of principal investigators by March 1, 1984."

This report is submitted in compliance with the request of the Senate Appropriations Committee.

The Space Telescope will be used as an observatory available to astronomers throughout the world. Data from the telescope will be received at the Goddard Space Flight Center and will then be transmitted to the Space Telescope Science Institute, which will have responsibility for science operations. The Institute is an independent science institute operated by the Association of Universities for Research in Astronomy, Inc. on behalf of the National Aeronautics and Space Administration (NASA). It is located on the Homewood Campus of Johns Hopkins University in Baltimore, Maryland. The Institute's Director is Dr. Riccardo Giacconi.

The science program conducted by the Space Telescope Science Institute will be done in such a way as to maximize the scientific usefulness of this space-based observatory. This approach is believed to be the best one to bring the user community in direct contact with and control of the science that is to be done with the instrument. The Space Telescope Science Institute will:

o Establish the science program guidelines for the Space Telescope.

o Select the Space Telescope observers and archival researchers.

o Fund US user participation.

o Provide direct technical support to observers before, during, and after their observations. These activities will be reviewed at least annually by NASA.

o Develop an integrated observing schedule to be used by the Operations Control Center at the Goddard Space Flight Center.

o Sponsor Space Telescope related research necessary for efficient use of the observatory.

o Evaluate the scientific performance of the Space Telescope observatory and its individual scientific instruments and advise NASA on observatory status.

- o Process, archive, and publicize the scientific data derived with the Space Telescope, making this information accessible to the public.
- o Conduct a program to encourage visiting scientists.
- o Establish a scientific staff to perform the above functions and conduct their own research related to the Space Telescope.

Users will have access to the Space Telescope through a competitive peer review process. Announcements for the opportunity to participate in such a competition will be made every six months, and these announcements will be sent to all members of the U.S. astronomical community as well as to astronomers throughout the world.

The Space Telescope Science Institute will develop the peer review procedures for allocation of observing time on the Space Telescope. These procedures will preserve commitments that NASA has already made to principal investigators and other members of the Development Phase Science Team and those described in the NASA/European Space Agency (ESA) Memorandum of Understanding. It is understood that a significant fraction of the observing time must be provided to qualified scientists who are not connected with the Space Telescope Science Institute or the Development Phase Science Teams. The Space Telescope Science Institute scientific staff members are expected to participate actively in the use of the Space Telescope but they will be required to compete for observing time with other astronomers on the basis of scientific merit. There will be a balance between short- and long-term programs and targets of opportunity. The Institute will develop and implement the policy regarding the treatment and balance of the program. It is expected that the peer review system will involve significant numbers of members of the astronomical community in the U.S. After receiving the recommendations from the peer review panels the Space Telescope Science Institute Director will select the general observers.

U.S. scientists who have been selected as general observers will be funded in order to cover expenses incurred in their approved research programs. These funds will be provided by NASA through the Space Telescope Science Institute. Expenses will include such items as related travel, computer time, graduate student support, new software development for enhanced calibration or analysis of Space Telescope science data, and publications. Funding of scientists who are Federal employees will be subject to applicable government regulations.

The Space Telescope Science Institute will support Space Telescope observations by all users as well as user data calibration and analysis. The staff will become thoroughly familiar with the instruments and Space Telescope operations and capabilities in order that it will be able to:

1) interface with space telescope observers to provide current observation-related information to ensure the most efficient use of the instruments;

2) assist users in optimizing their proposed scientific programs; and,

3) promote and suggest correlated research programs of other space systems and ground observatories to obtain the best scientific return from the Space Telescope.

Discoveries made with the Space Telescope are expected to signficantly increase demand for ground-based observing time. The National Science Foundation (NSF) has lead agency responsibility for the support of ground-based astronomy. In fulfilling this responsibility, the Foundation provides operational funds for the National Observatories and provides research grants to scientists at universities. Proposals to use telescopes at the National Observatories to follow up on Space Telescope discoveries will be subject to the normal review processes at each observatory. In addition, the Foundation expects to receive regular research proposals from university scientists to use university-based telescopes to investigate the implications of discoveries made with the Space Telescope. It is the Foundation's intention to have such proposals reviewed through the normal peer review process.

The National Aeronautics and Space Administration and the National Science Foundation have consistently coordinated their efforts in the support of research in astronomy. Space-based instruments such as the International Ultraviolet Explorer, the High Energy Astronomical Observatory, and the Infrared Astronomical Satellite have provided significant new information on the universe about us. Throughout this period NASA and NSF have worked together to ensure that the community is involved in all aspects of the selection of principal investigators. NSF staff regularly participate in the selection process of users for various space observatories. There is continual communication between the staffs of both agencies, and regular meetings are held in order to coordinate current activities and future planning efforts with regard to both ground-based and space-based projects. It is the intention of both agencies to continue this active and very important cooperative effort, and to maintain close lines of communication with each other during the period prior to, during, and following the launch of the Space Telescope.

Jr. 2/9/84
Charles J. Pellerin, Director
Astrophysics Division
National Aeronautics and Space
Administration

Laura P. Bautz 1/27/84
Laura P. Bautz, Director
Division of Astronomical Sciences
National Science Foundation

Questions Submitted by Senator Huddleston

Department of Defense Use of Space Shuttle

Question: What is the current policy for pricing DOD use of the Shuttle? In dollar terms, what will be the DOD contribution in FY 1984? FY 1985?

Answer: The current NASA/DOD agreements on Shuttle use contain the following provisions for prices of DOD launches:

- DOD will pay $16.0 million (FY 1975 dollars) for materials and services per launch in FY 1984 and FY 1985.

- For DOD launches in FY 1986 through FY 1988, they will pay $29.8 million (FY 1975 dollars) per launch.

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In dollar terms, DOD reimbursements in FY 1984 are $75 million; in FY 1985, $330 million.

Question: How many Shuttle missions has DOD decided to cancel? What is the reason for cancelling each? How will each be flown or what alternative will be used?

Answer: Since the FY 1984 President's Budget, the DOD has cancelled three dedicated-Shuttle flights-- one in FY 1985 and two in FY 1987. All were cancelled on the Shuttle to allow use of remaining (i.e., spare or backup) Titan 734D launchers. An additional impact on the STS manifest and anticipated reimbursements for the Shuttle program has been the delay of several DOD payloads to later points in the schedule.

Question: The Air Force has $10 million in its request to the Defense Subcommittee for ELV's. Have you discussed this matter with the Air Force? What impact will it have on DOD use of Shuttle? Is there any way the Shuttle can compete with the new 65,000 pound lift ELV or the proposed heavy lift one?

Answer: NASA and the Air Force have discussed the Air Force proposals to procure ten Titan/Centaur launchers for use at ETR as backup for planned STS/Centaur launches.

The impact on DOD use of the Shuttle would be a reduction in STS/Centaur launches at ETR. The maximum projected reduction in STS/Centaur launches under the current DOD plan would be two per year from 1988 through 1992.

NASA's analyses have shown the Shuttle to be competitive with ELV's for the 65,000 pound class of payload.

One of the prime candidates for the proposed "heavy lift" launch vehicles is a Shuttle-Derived Launch system that could be used by both the Air Force and NASA to place very large payloads in near-earth orbit. This system should be compatible with the existing Shuttle system and its use therefore could complement the Shuttle.

NASA/VAFB ACTIVITIES

Question: Please describe briefly NASA's involvement in current Vandenberg activities. How many NASA employees are there?

Answer: NASA is providing support to the Air Force at Vandenberg on a reimbursable, as requested, basis. Currently, NASA is providing assistance in the design, acquisition, activation, and operation of Shuttle facilities and equipment. NASA currently has sixteen employees at Vandenberg in support of the Air Force Vandenberg activities.

Question: When does NASA expect to utilize Vandenberg for a civilian flight?

Answer: NASA's first planned STS/Vandenberg flight is flight 62-B in April of 1986, the second STS flight from Vandenberg. It may include the repair/retrieval of the Landsat spacecraft.

Fifth Orbiter

Question: Under existing projections, when would you expect to need a fifth orbiter for the Space Shuttle?

Answer: NASA has continued to study the need for additional Space Shuttle orbiters. These examinations have focused upon impacts of the loss or extended downtime of one of the currently authorized four orbiter fleet and on the likelihood of future traffic growth beyond current capability. These studies have indicated that the current fleet should be sufficient for at least the remainder of this decade. However, concern was expressed on the need for assurance to accommodate unscheduled maintenance or accidents causing extensive damage or loss of an orbiter.

For this reason, an orbiter structural spares program was initiated in FY 1984. This program provides additional assurance in maintaining Shuttle operations and also protects orbiter production capability for some of the key contractors. This program along with the operational spares program, in our judgment, represents the optimal approach to retention of the planned orbiter fleet and the option to proceed with full production of an additional orbiter at a later date if necessary. This issue will be reviewed again as part of the FY 1986 budget formulation process.

Question: The House Authorizing Subcommittee added $50 million for orbital structural spares and for maintaining production capability. Should this amount be approved, what is the total amount spent to date for spares and maintaining the production line for the fifth orbiter?

Answer: $20 million was spent in FY 1983 on the orbiter structural spares program and $100 million is authorized for that purpose in FY 1984. $420 million total is planned for the structural spares program which supports a continuing production capability into FY 1987.

Production capability is also maintained through the logistics program which provides spares for the continued operations of the Shuttle. Many second and third tier orbiter supplier manufacturing capability is maintained by this program. In FY 1983, $133 million was authorized for this purpose and $215 million in FY 1984. The current budget contains a request for $289 million for orbiter spares.

Question: What is the total projected cost of the fifth orbiter?

Answer: Costs for procurement of a fifth orbiter, including the $420 million planned for structural spares, are as follows:

FY 1985 Start - mid 1989 delivery:	$1.95 billion
FT 1986 Start - mid 1990 delivery:	$2.2 billion

Question: Is there any tentative decision within NASA on if and when to request a fifth orbiter?

Answer 9: The current FY 1985 budget now before Congress does not request funds for a fifth orbiter. Studies over the past several years have shown that the currently authorized four orbiter fleet will meet projected demands through the remainder of the decade.

Lead times for production of an additional orbiter are on the order of 4 1/2 years so that starts in FY 1986 and FY 1987 would yield orbiters in 1990 and 1991. These lead times and the potential additional cost of OV-105 have benefitted by the orbiter structural spares programs. That program is procuring key structural assemblies to support flight operations.

NASA had made no decision to request a fifth orbiter but will continue to study the need for it in the process of the FY 1986 budget preparation.

Space Shuttle - Commercial Use

Question: How many private companies have actually signed up for use of the Shuttle for commercial purposes? Is most of the interest in research & development or are there actually manufacturing and production possibilities? Does any private firm currently expect to realize a profit on spaced-produced items?

Answer: There are 21 companies, excluding foreign governments, which have signed-up to use the Shuttle. They are:

Satellite Business Systems	Communications
TELESAT Canada	Communications
Hughes Communications	Communications
American Satellite Co.	Communications
AUSSAT Pty, Ltd	Communications
Radio-Tele-Luxembourg	Communications
Ford Aerospace Satellite Services Corportation	Communications
INTELSAT	Communications
Fairchild Space Co.	Leasecraft
ORION Satellite Co.	Communications
RCA Americom	Communications
McDonnell Douglas Corporation	Pharmaceuticals
SPARX Corporation	Earth Resources
MBB	Scientific
Satellite TV Corporation	Communications
United Satellites Ltd	Communications
United States Satellite Services Incorporated	Communications
United States Satellite Broadcasters	Communications
Western Union Telegraph Co.	Communications
OSL	Environment Monitor
Commercial Cargo Spacelines	Shuttle Brokering

The majority of these private companies who have signed up for flights are using the Shuttle for communications satellites with the interest of providing profitable operations. Several companies have entered into Research and Development JEA's with the anticipation that manufacturing/production in space will prove to be profitable; e.g., McDonnell Douglas with their Electrophoresis Operations in Space (EOS) and Fairchild with the Leasecraft Satellite.

Question: How are costs for Shuttle use determined for potential space manufacturers? I understand that GTI cancelled a joint endeavor agreement over costs. Is that correct? What were the problems?

Answer: Potential space manufacturers may launch their payloads on the Shuttle for a price based on the same dedicated flight price as any other commercial customers.

If the potential space manufacturer is a United States dometic concern, it may qualify for a Joint Endeavor (JEA) with NASA. In general, JEA's are for the purpose of: (1) engaging in research programs directed to the development and/or enhancement of Materials Processing in Space, and (2) encouraging commercial applications of Materials Processing in Space technology.

In joint endeavors, NASA and the industrial concern share in the cost and risks of the endeavor. Terms and conditions, including the business arrangements, are negotiable, on a case-by-case basis, within the limits of prevailing statutes and regulations and will be commensurate with the risks, involvement, and investment of all the parties.

It is true that GTI cancelled a joint endeavor agreement. GTI indicated a lack of industry response to their concept which reduced their ability to fund development of their hardware as their reason for withdrawal.

Question: How does a Shuttle launch currently compare cost-wise to an Ariane one? Is there any indication of preference in the communications industry for one over the other? What factors should make the Shuttle more attractive?

Answer: The Ariane's price is not published and apparently is subject to negotiation with each customer. In several cases where we were able to compare launch prices, the Ariane launch price was lower than Shuttle's, even after adjusting for higher insurance rates.

In light of the price differential, we believe customers have chosen Shuttle because of NASA's 25 years of experience in the launch service area and because NASA was better able to meet their launch needs.

Question: Have you made any recent change in Space Shuttle pricing for commercial uses and would you anticipate any before the end of FY 1985?

Answer: The price for commercial customers of the Shuttle for launches in FY 1986 through 1988 was set in June, 1982. Since customers begin to make payments 33 months prior to launch, it is our policy to set prices three years in advance of the year of launch. Therefore, we are beginning to develop our prices for FY 1989 and beyond; we anticipate setting them before the end of FY 1985.

Question: How do you respond to the claim that Shuttle launches up to 1989 for communications satellites will be highly subsidized by the taxpayers, perhaps as much as $100 million?

Answer: The price for Shuttle launches in FY 1983, 1984, and 1985 was published by NASA in 1977. This policy was based on the principle that the Government should recover its total operating costs over a 12 year operating horizon and that NASA should charge a fixed, flat rate price for the first three years based on the then projected 12 year average cost to enhance transition to the Shuttle.

The underlying principles of the 1977 Shuttle Reimbursement Policy were to encourage full and effective use of the shuttle; to effect an early transition from expendable launch vehicles (ELV's); and to recover the operating costs incurred in providing launch services, as well as set a fair rate structure by charging each class of customers on the basis of Shuttle capability required and on a non-discriminatory basis for similar services. The goal was to recover the Shuttle's operating costs over the first twelve years of operations; no attempt was planned to recover U.S. Government expenses for Shuttle development. However earlier projections of shuttle operating costs have not been realized primarily because of lower flight rates in addition to increased costs.

Based on the projections of total operating costs, the price of a dedicated Shuttle flight was set at $18 million (FY 1975 dollars), subject to escalation. Customers requiring only a section of the orbiter cargo bay were charged a percentage of the Shuttle dedicated flight price based on the size or weight of the payload. Shared Shuttle flights permitted smaller payloads to fly at relatively low costs.

In June, 1982, the decision was made to adopt a three year Phase II pricing policy for launch in FY 1986-1988, based on a projected three year average out of pocket costs. The price for a dedicated Shuttle launch was set at $71 million in FY 1982 dollars ($38 million FY 1975 dollars).

The basic principle of this pricing policy is that the Shuttle is a national asset which is required for U.S. Government launches, and is available to all users. The cost basis for this policy was intended to recover NASA's out-of-pocket expenses.

Under the out-of-pocket costing concept, commercial and foreign customers of the Shuttle are charged a price based on the projected average total cost per flight for consumables (hardware items such as external tank, solid rocket boosters, etc.) plus the additive cost of launch operations and flight operations to support these flights. This policy should result in the commercial and foreign customers of the Shuttle paying not only the direct cost incurred by the Government for their launches but also in making a contribution to the base cost for launching the required U.S. Government launches. For example, in Phase II (FY 1986-1988) the dedicated Shuttle price charged to commercial and foreign customers is $71 million (FY 1982 dollars) per flight. Although the currently estimated full average cost for shuttle flights during this period is approximately $105 million (FY 1982 $), the total marginal cost to fly these customers, beyond the cost for the required U.S. Government launches, is estimated at $43 million (FY 1982 $) per flight. Charging the $71 million price actually lowers the cost that the U.S. taxpayer has to pay for the U.S. Government launches of Shuttle.

Insurance on Shuttle Missions

Question: Prior to the loss of the two telecommunications satellites, insurance premiums were running five to six percent of value. What are they today?

Answer: The effects on Shuttle insurance rates of the loss of WESTAR VI and PALAPA B-2 is still unknown; however, there is little doubt that rates, not only for Shuttle but for all launch systems, will go up.

Senator Huddleston--Continued

Question: Have premiums for Ariane launches increased?

Answer: It is too soon to tell what effect the loss of the two telecommunications satellites on STS-41B will have on Ariane insurance rates. Preliminary indications are that insurance rates for both Ariane and the Shuttle will increase to some extent.

Question: To what extent are scheduled launches now already covered by insurance?

Answer: All NASA customers scheduled for launch in 1984 already have insurance in place, i.e., SBS, Telesat Canada, AT&T Communications and Hughes Communications.

Question: Did NASA incur any expense as a result of the two losses?

Answer: NASA has incurred no expenses as a result of the two losses. We have offered to assist McDonnell Douglas, the developer and manufacturer of the Upper Stage, in their efforts to correct the PAM-D problems in recognition of the potentially serious impact these losses can have on the Shuttle manifest.

Question: Do you expect the losses to affect future Shuttle traffic?

Answer: NASA does not expect any negative long-term effect on Shuttle traffic from this loss of WESTAR VI and PALAPA B-2, in fact, both customers (Western Union and the Government of Indonesia) are planning replacement missions on Shuttle. We fully anticipate that McDonnell Douglas will correct the PAM-D problem and the impact on the Shuttle mission model will be limited to a possible near-term rephasing of requirements.

Question: Do you believe you have lost any Shuttle traffic to Ariane as a result of the losses?

Answer: NASA does not believe any Shuttle traffic has been lost to Ariane as a result of the WESTAR VI/PALAPA B-2 losses.

Retrieve and Repair

Question: The Shuttle will soon be used for a retrieve and repair effort in connection with the Solar Maximum Mission. Is this project on schedule without difficulties?

Answer: The Solar Maximum Repair Mission is on schedule and there are no difficulties being experienced with either the cargo elements or the Space Shuttle itself. The launch is scheduled for April 6, 1984.

Question: To what extent can a retrieve and repair function be utilized with existing technologies and capabilities?

Answer: The technology exists today to incorporate on-orbit maintenance and servicing into spacecraft designs. Many existing spacecraft could have benefitted from these services had they considered maintenance and servicing in their design as in the Solar Maximum Mission spacecraft which is to be retrieved and repaired during the flight of STS-41C. Of importance currently are the Western Union and Indonesian communications spacecraft launched on STS-41B. These spacecraft can be placed in a Shuttle compatible orbit but their retrieval is greatly complicated by not having equipment designed into the spacecraft to enable Shuttle grapple or stowage in the cargo bay. Nevertheless, with some effort and expenses, these spacecraft can probably be grappled and stowed on a makeshift cradle in the cargo bay and returned to earth.

Question: To what extent is a retrieve and repair capability being built into satellites being launched today?

Answer: Many of the spacecraft in development or in use have maintenance and servicing as a major design consideration. In fact, the Space Telescope, the Gamma Ray Observatory, Landsat, SPAS, SPARX, Leasecraft, and a number of other spacecraft are being designed for retrieval and maintenance. The successful Solar Maximum Repair Mission will undoubtedly spur other planned spacecraft into considering on-orbit maintenance and servicing to achieve long-duration operation.

Question: After SMM, when would you anticipate another retrieval and repair effort?

Answer: Depending on NOAA's needs and funding, the next potential retrieval and repair would be targeted for the Landsat-4 spacecraft in 1986 after the Vandenberg Air Force Base is an operational Shuttle launch site. In addition, there is an opportunity to retrieve the recently launched Western Union and Indonesian communications spacecraft that failed to reach their servicable orbit. However, any mission to retrieve the communications satellites must be authorized by the spacecraft owners and negotiated with NASA for the retrieval operations.

Landsat

Question: NASA launched the last Landsat on March 1. How long is it expected to function?

Answer: The design lifetime for Landsat-5 luanched on March 1, 1984, is three years. Every effort will be made, however, to assure a longer life than three years.

Question: With the launch of this satellite, is NASA's role in Landsat effectively terminated?

Answer: NASA will continue to be involved in the Landsat program in several ways; for example, NASA will continue to manage the Thematic Mapper instrument operations and ground data processing for both Landsat-4 and -5 until the scheduled turnover of these functions to NOAA in January, 1985. NASA will also be conducting science investigations with Landsat data for the next several years. In the case of Landsat-4, NASA is currently studying for NOAA various options for a possible future repair (in orbit) and/or retrieval.

Question: The Commerce Department has requested bids for private takeover of the existing system or to propose a replacement system. Is NASA being consulted about this?

Answer: NASA has been consulted by the Department of Commerce in regard to the possible takeover of the Landsat system by the private sector. We have participated with the Department of Commerce for over a year with representatives on a Technical Advisory Committee that assisted in the preparation of the Request for Proposals for commercialization of the Landsat system. NASA has a member on the Source Evaluation Board that is in the process of evaluating the proposal submitted to the Department of Commerce in March, 1984, and is also a member on the Technical Advisory Committee that is supporting the Source Evaluation Board.

Question: Has NASA been asked to do any recent evaluation of potential private efforts to takeover the system? I understand interest in the private sector is not as great as originally anticipated.

Answer: The only evaluation NASA has been asked to do in regard to potential private sector efforts to take over the Landsat system have been in conjunction with the Department of Commerce as members of the Source Evaluation Board and the Technical Advisory Committee supporting the Board.

Question: When should construction on a follow-on satellite begin, if there is to be no gap in service after Landsat just launched?

Answer: Based on the designed three year lifetime for Landsat-5, a replacement spacecraft should be ready for launch in the 1987 timeframe in order to leave no gaps in service. In order to construct a follow-on satellite to assume timeliness of data, long lead-time item procurement activities should be initialized in 1984.

Question: To what extent can Landsat-type functions be carried out on the Shuttle? Is this economically feasible?

Answer: Landsat-type functions are characterized by the repetitive nature of the observations (every 16 days) and the large synoptic view (100 x 100 nautical miles). Neither of these functions could be achieved from a Shuttle mission, due to the operational altitude of the Shuttle and limited length of flight duration. In addition, the cost of continued Shuttle missions to obtain the desired Landsat-type of data would not bye very economical.

Question: Is NASA pursuing any Research and Development (R&D) in order to maintain an advanced remote sensing capability? How much is in the FY 1985 budget for this and for what particular programs?

Answer: In our Solid Earth Observations program, NASA is pursuing R&D in several areas, and in varying intensities, in order to maintain an advanced remote sensing capability. Specific examples are the Shuttle Imaging Radar (SIR) and the Multispectral Linear Array

(MLA). The SIR-B is scheduled for launch in August, 1984. We are also investigating the implementation of the next logical upgrades to SIR-B (SIR-C and SIR-D) to further develop the technology and science associated with multi-frequency, multi-polarization spaceborne imaging radar systems. Some MLA instrumentation is scheduled for launch in the 1987 1988 timeframe to demonstrate the use of linear arrays in remote sensing. The MLA program also supports an R&D effort to develop electro-optical area arrays capable of providing two-dimensional (spatial and spectral) resolution. The FY 1985 budget assumes a level of approximately $18 million for MLA and SIR activities.

Question: What is the status of the multi-linear spectral array? What is the spending profile for this program?

Answer: The Multispectral Linear Array (MLA) is currently scheduled for launch in the 1987/1988 timeframe. The funding ranges from approximately $9-$15 million over the next five years, including science support.

Question: What are the next most promising technologies in the remote sensing area?

Answer: The most promising technologies in the remote sensing area appear to lie in the areas of extended capabilities for Synthetic Aperture Radar (SAR) and Advanced Spectrometer type sensors. To bring together a group of remote sensing instruments which capitalize on the advantages of these sensors requires continued development in the general areas of detector technology, high power amplifiers, on-board data processing/compression, optical and antenna technology, and high bit rate communications, to name a few. Specific technologies which are particularly promising include advancement of the electro-optical sensor knowledge; development of a spaceborne imaging spectrometer and a multi-frequency and development of a multi-polarization SAR. Inherent in this effort is the need for large solid state area arrays (tens of thousands of detectors), advanced optical design and data handling technology, distributed SAR antennas and a phase array SAR.

Question: Has the AgRISTARS program simply disappeared?

Answer: NASA's involvement in AgRISTARS will be phased out in an ordely manner by the end of FY 1984. It is anticipated, however, that coordination of relevant NASA remote sensing research program components with the USDA and NOAA will continue in the future. It is our understanding that NOAA and USDA plan to continue their AgRISTARS programs in FY 1985.

The three agencies--NASA, NOAA and USDA--plan a joint AgRISTARS accomplishments symposium in the summer of 1985.

Question: If Landsat is commercialized along the lines currently being discussed, do you foresee any future research and development role for NASA in the remote sensing area?

Answer: NASA most definately has a role to play in future remote sensing R&D regardless of the outcome of the Landsat commercialization process. Assuming that management of the existing Landsat system s transferred into the private sector under the supervision of the Department of Commerce, NASA's R&D efforts would still be concentrated in two areas: to continue utilization of data being produced by the Landsat system within our earth science and applications programs to continue data analysis activities by focusing on long-term studies of changing environmental conditions that could eventually impact the habitability of our planet; and to continue to explore the utility of emerging technology for global earth observations. It is important to recognize that the existing Landsat system was designed in the mid-to late 1970's, and it largely reflects the state-of-the-art in sensor capabilities and data processing technology that existed at that time. Recent technological advances could be exploited to develop far more sophisticated sensor systems for future earth observations. We are currently pursuing an aggressive instrument development program that will enable us to evaluate the utility of new, advanced remote sensing techniques for earth observations. The Shuttle Imaging Radar, the Multispectral Linear Array and the Shuttle Imaging Spectrometer experiments are examples of our attempts to evaluate the utility of advanced remote sensing technology. Our research in this area is largely concerned with determining what types of earth information can be derived from the measurements obtained by these advanced sensor systems, and how this information can be incorporated into better understanding the earth as an integrated system.

Space Infrared Telescope Facility

Question: What has been done to date on the Space Infrared Telescope Facility (SIRTF)? Originally, the Phase B study on SIRTF was scheduled to begin in FY 1985. Why is this not in the budget? What are current plans for the Phase B study now?

Answer: The success of the IRAS has demonstrated the scientific need for SIRTF and the technologies of long-lived dewars and superfluid helium management in zero gravity. Discovery of the glow surrounding the Shuttle in its relative low-orbit has also produced new information pertinent to infrared astronomy. These new data have caused us to reexamine the implementation mode for SIRTF; therefore, we are reviewing various potential SIRTF options, two of which include a free-flyer mode and a Shuttle-attached payload mode. As a consequence of this reexamination, we are not prepared to initiate full-scale Phase B studies in FY 1985.

Question: What was the original timeframe for the SIRTF program and what will it be if the Phase B study slips?

Answer: Proposals for scientific investigations have been received in response to the SIRTF Announcement of Opportunity and are undergoing evaluation. Subsequent to a decision regarding the implementation options, the Phase B Request for Proposal will be released. Our current assessment is that the earliest we envision SIRTF to be considered as a new start is in the FY 1987 1988 timeframe.

Question: What would be the cost of proceeding with the Phase B study in FY 1985?

Answer: We estimate that approximately $20 million will be required over a two to three year period to conduct Phase B observatory and instrument definition studies. Therefore, the amount required in FY 1985 is dependent on when a Request for Proposal is released and subsequently when Phase B studies can be initiated.

Question: Did NASA made a request to OMB for SIRTF?

Answer: NASA did not request funding from OMB in FY 1985 for SIRTF as we are not prepared to initiate Phase B studies due to the reexamination of SIRTF.

ACTS

Question: What is the current status of the ACTS program and how does NASA intend to deal with the RCA contract? What would you expect the status to be at the end of the year?

Answer: The ACTS program has been restructured to include technology development for future communications satellites including subsequent ground testing. The RCA proposal covered technology elements which we plan to address in the ground test program as well as the flight test; therefore, we will not sign a contract with RCA as proposed by RCA. We currently plan to have a technology development and ground test program planned in detail by the end of the year.

Question: The House Authorization Committee included bill language suggesting that NASA consider recompeting the ACTS program. What would this involve? What would the legal ramifications and the costs be?

Answer: The bill language specifically called for an ACTS flight program. If a flight program were recompeted, this would cause at least a one year delay in awarding a contract and beginning work, consequently the cost would most likely increase. Recompetition could potentially result in a protest from RCA.

Question: The House Authorization Committee added $40 million for the ACTS program. Should this be enacted, any rescissions rejected, etc., how would you expect to proceed?

Answer: NASA proposed a technology development and ground test program after private industry indicated their intent to develop nearer-term communication satellite technology requirements. We currently see no reason to change our position on the ACTS program.

Question: In hearings in the House, NASA estimated at one point that the Hughes Galaxy filing overlapped 10 percent with ACTS; at another point 35 percent. What was the basis for each of these estimates?

Answer: The 10 percent and 35 percent figures referred to were educated guesses about the extend to which the Hughes filing would actually achieve the specific objectives identified in the ACTS flight demonstration. There is obviously wide latitude for interpretation on such a question. The 10 percent figure was made in the context of the overall technology demonstration including user experimentation with ground terminals and applications. The higher figure (35 or 40 percent) focused on the research results that might be expected from opening a new frequency band that could provide fundamental understanding of the effects of heavy rain at higher frequencies, and other basic technical information.

Question: What would be the impact of Hughes not proceeding? Suppose we didn't learn of this decision for 15 to 18 months or so?

Answer: NASA would have to re-assess communication satellite technology needs and timing if Hughes made the decision not to proceed with their planned 30/20 GHZ communication satellite development activities.

Question: Please provide an up-to-date spending profile on ACTS as currently proposed by NASA and the original proposal with the flight test phase.

Answer: The following is the FY 1985 ACTS flight test program submitted to OMB, assuming a launch in 1988.

($ in millions)

Prior	FY 1984	FY 1985	BTC	Total
20.0	5.0	92.0	208-308	325-425

The restructured ACTS program which excludes a flight test is as follows:

($ in millions)

Prior	FY 1984	FY 1985	BTC	Total
20.0	5.0	5.0	25-30 per year	100-130

European Participation in Space Station

Question: What types of European participation have you been considering for the Space Station?

Answer: No specific European proposals are currently under consideration. It is anticipated that European proposals for participation in the Space Station definition phase will be forthcoming later this year.

Question: How did you derive the $1 billion which has been mentioned as a possible European contribution?

Answer: On my visit to Europe in March, I emphasized that we would want their participation to be meaningful. Based on the budgets for space activities in European countries, I estimated that a range of about $1.5 to $2.0 billion would constitute meaningful participation by the Europeans in the Space Station program.

Question: The $1 billion has been mentioned in connection with the $8 billion manned Space Station concept. If a more evolutionary program were approved, what kind of a European contribution would you anticipate?

Answer: For any European participation to be meaningful, it must be followed by support during the operational phase of the Space Station program. A more evolutionary program could impact the timing of the contribution.

Question: What legal interests or rights would the Europeans have?

Answer: The legal interests and rights of the Europeans in the Space Station program will be a matter for negotiation and dependent upon their specific contribution and continuing support to the program.

National Space Technology Laboratories

Question: Last year we discussed the role of NSTL in the development of the main engine and the Shuttle main propulsion system. Has this mission changed any?

Answer: The basic mission of NSTL in the main engine and the Shuttle main propulsion system development remains the same, i.e., to support engine and system hot-fire testing. There is a planned increase in the testing level at NSTL in the FY 1985/1986 timeframe. During this period, we intend to utilize the curent multiple engine MPT stand, B2, for additional single engine testing.

Question: NSTL is also involved in remote sensing activities. Do you anticipate any change in these activities during FY 1985 or the outyears?

Answer: The NASA remote sensing research is being redirected from a short-term applications program to an earth sciences and long-term applications program. The Earth Resources Laboratory (ERL) at NSTL has traditionally been an applications and technology transfer center, a role at which they have excelled. During FY 1985 and beyond, it is expected that the ERL will continue to be involved in the remote sensing.

Question: Has the $3.4 million appropriated in FY 1984 for Construction of Facilities been obligated?

Answer: All but $375,000 of the FY 1984 CofF program at NSTL is presently under construction. The only remaining item will be awarded in May 1984.

Question: Please explain the details of the FY 1985 construction request.

Answer: FY 1985 construction request for NSTL includes one major project, "Modification for Single Engine Testing," six repair projects, three rehabilitation and modification projects, and one minor construction project.

The purpose of the major project is to modify the Main Propulsion Test (MPT) Stand (B-2) to provide the capability for single Space Shuttle Main Engine (SSME) testing for engine improvements, life extension of components and greater reliability. The repair projects include protective coatings for exposed metal structures, repairing electrical and high pressure gas systems, replacing insulation on the high temperature hot water lines, and repairing sewage lines and asphalt roads. The rehabilitation and modification request includes a safety project to relocate to above grade all the high pressure gas valves that are located in pits, improvements to the liquid oxygen delivery system to the Space Shuttle Main Engine A-1 Test Stand, and modifications to the Communication Building to accommodate new communication network equipment. The Minor Construction project provides for a 3,000 square foot addition to the building which houses the NSTL central computer system to accommodate new equipment and consolidate existing equipment.

Question: The R&D budget of NSTL dropped from approximately $24 million in FY 83 to $13 million in FY 1984. What is the R&D budget for FY 1985?

Answer: The FY 1985 Congressional Budget, page AS-13 shows the following direct NASA funding for NSTL:

	FY 1983	FY 1984	FY 1985
	($ in millions)		
Research and Development	7.6	8.3	8.3
Space Flight Control and Data Communications	.7	-	-
Construction of Facilities	-	-	3.0
Research & Program Management	6.3	9.8	10.9
Total Direct Appropriations	14.6	18.1	22.2

Technology Utilization

Question: As of December 31, 1983, some $8.3 million of your FY 1984 Technology Utilization funds had not been utilized. Is the record better now?

Answer: As of December 31, 1983, the Technology Utilization Office had committed approximately $4.4 million of the FY 1984 appropriated $9.0 million; however, actual obligation of the funds occurs as each contract is negotiated (a process which usually requires several weeks). As of March 15, 1984, approximately $8 million of the Technology Utilization appropriation had been committed; the actual obligation of these funds should be reflected in the NASA accounting system over the next few months.

Question: Please describe the university-based dissemination network, including the participants. How does NASA support for these programs compare with that from private industry?

Answer: NASA operates the "university-based dissemination network" to provide information retrieval services and technical help to industrial and Government clients. The network consists of nine technical information dissemination centers. Funding for the Centers is shared by NASA and the dissemination centers with operating expenses offset by income derived from users of the Centers. The Centers respective funding contribution is based on their respective capabilities. A list of the Centers and their university affiliation follows:

Aerospace Research Applications Center
    affiliated with Indianapolis Center for Advanced Research which is affiliated with the University of Indiana and Perdue University

Computer Software Management and Information Center
    University of Georgia

Kerr Industrial Applications Center
    Southeastern Oklahoma State University

NASA Industrial Applications Center
    University of Pittsburgh

New England Research Application Center
    University of Connecticut

North Carolina Science and Technology Research Center
    affiliated with the Research Triangle Institute which is affiliated with North Carolina State University, University of North Carolina and Duke University

Technology Application Center
    University of New Mexico

NASA Industrial Applications Center
    University of Southern California

NASA Florida State Technology Applications Center
    State University System of Florida, located at University of Florida

NASA/UK Technology Applications Program
    University of Kentucky

Question: Your budget justification refers to "realignment and restructuring" of the dissemination program. What does this mean?

Answer: During the past year, the Technology Utilization Office has initiated two major efforts toward providing a more effective and broader technology dissemination program.

First, new techniques have been impelmented in the Industrial Applications Center network which will allow for a higher volume of searches and the opportunity for more effective linkages with State universities and economic development organizations. Some of the new techniques include remote interactive search systems, electronic mail, and advanced computer retrieval methods. At the same time, NASA has expanded the charter of the Florida Center, formerly a state-oriented center, to afford states in the Southeastern tier an opportunity to tie in to this center.

Second, NASA is implementing the conversion of NASA Tech Briefs, the primary technology announcement mechanism, to a commercial publication. NASA will continue to supply the technology information, and the journal will continue to be offered free to subscribers; however, a private publisher will recoup costs through advertising. It is anticipated that this conversion will result in dissemination of NASA technology information to a broader and larger audience and cost savings to the Government.

Question: What activities do you expect to undertake under the NASA-University of Kentucky TAP program during the remainder of FY 1984 and in FY 1985?

Answer: In FY 1984 and 1985, NASA will continue to work through the Kentucky Technology Applications Program (TAP) to transfer NASA technology to state and local government entities within Kentucky and to seek out new opportunities for providing service to small businesses within the State. In addition, we will expect ways to assist TAP in making contacts within some large companies, a segment which has not been fully exploited within Kentucky, to attempt to match NASA technology with specified technical needs of these companies.

QUESTIONS SUBMITTED BY SENATOR INOUYE

INFRARED TELESCOPE FACILITY

Question: What is the status of your talks with NSF/NASA regarding the IRTF?

Answer: A number of discussions were held with officials at the NSF regarding the IRTF. The outcome of these discussions was a mutual acknowledgement of the fact that while the NSF is the lead agency for ground-based astronomical research, there are some ground-based astronomical research activities required by NASA in support of its mission. Careful coordination between NSF and NASA is maintained concerning the support of such work.

The Infrared Telescope Facility (IRTF) was developed by NASA to obtain observations to support the NASA solar system exploration program. It plays a unique role in providing direct scientific and operational support. The demands for observing time which the NASA program places on it require approximately one-half of the total available observing time.

To acknowledge this situation and to optimize the benefit of the IRTF to both NASA and the astronomical community at large, an agreement was formalized between NASA and the NSF wherein:

- NASA will, subject to the availability of funding, provide long-term operational support for the IRTF to provide the management control needed to assure that the agency's mission-oriented objectives will be attained and that high quality astronomy research will be possible using the Facility.

- NSF will endeavor to provide support for the development of instrumentation for the IRTF needed to maximize the value of the Facility to the general astronomical community. Provision of such support will be dependent on the receipt and evaluation of appropriate proposals which are to be reviewed on the basis of their merit following standard NSF procedures.

- NASA will reexamine the role of the IRTF in its programs periodically, at intervals of approximately 5 years. Should it become apparent on the basis of this reexamination that the IRTF is no longer required to support its mission, NASA will initiate timely discussions with the NSF and/or other interested parties concerning future support of the Facility.

RESEARCH ON MAUNA KEA

Question: What if any are your future plans for research on Mauna Kea?

Answer: NASA plans to continue support of a long term astronomical research program on solar system objects using existing telescopes on Mauna Kea including, but not limited to, the IRTF. There are no plans for NASA support for new facilities at the site.

QUESTIONS SUBMITTED BY SENATOR DECONCINI

SHUTTLE INFRARED TELESCOPE FACILITY

Question: I am concerned about an apparent reversal in NASA's plans for a Phase B Study of Shuttle Infrared Telescope Facility (SIRTF). It was my original expectation that the Phase B study would be undertaken in fiscal year 1985, however I was disappointed to see that NASA had failed to budget for this study in the FY 1985 budget. What are the reasons for this change?

Answer: The success of the IRAS has demonstrated the scientific need for SIRTF and the technologies of long-lived dewars and superfluid helium management in zero gravity. Discovery of the glow surrounding the Shuttle in the relative low orbit has also produced new information pertinent to infrared astronomy. These new data have caused us to re-examine the implementation mode for SIRTF; therefore, we are reviewing various potential SIRTF options two: of which include a free-flyer mode and a Shuttle attached payload mode. As a consequence of this re-examination we are not prepared to initiate full-scale Phase B studies in FY 1985.

Question: What would be the cost to begin a Phase B study of SIRTF in FY 1985?

Answer: We estimate that approximately $20 million will be required over a two to three year period to conduct Phase B observatory and instrument definition studies. The amount required in FY 1985 is dependent on when a Request for Proposal is released and subsequently when Phase B studies can be initiated.

FUNDING FOR PLANETARY RESEARCH

Question: Last year, Congress substantially increased the budget for Planetary Research. This year NASA came back to Congress with a level for planetary research below last year's level. Why does NASA continue to reduce this program when it is clearly Congressional intent to increase funding for planetary research?

Answer: The FY 1985 budget request for Planetary Exploration reflects an attempt to maintain a balance between flight mission activities and research. As you are aware, the FY 1985 budget request includes a new start for the Mars Geoscience/Climatology Orbiter mission, which will provide additional support to the science community in the years ahead. Therefore, we believe we have requested a viable, well-balanced Planetary Exploration program.

QUESTIONS SUBMITTED BY SENATOR DOMENICI

SPACE STATION

Question: You have referred to the Space Station as the "next logical step" for NASA to take. Once a Space Station capability is established, what is the next "logical step" beyond that and how will the Space Station and Shuttle system support it?

Answer: NASA believes that the Space Station is the next logical step in space because the Space Shuttle now can provide routine and dependable transportation to Earth orbit. As a place to shuttle to, the Space Station will provide a permanent, versatile capability in space for the conduct of science, the development of new technologies and the support of commercial endeavors. Once the Space Station becomes operational in the early 1990's, a number of possibilities will emerge as to what becomes America's next step in space. These possibilities include the establishment of a scientific base upon the moon, the occupation of space at geosynchronous altitude, and a "sample return" mission to Mars. The Space Shuttle and Space Station support these future possible endeavors by providing an operational staging base and point of departure for such expeditions.

Question: What would be the effect of a "freeze" at the FY 1984 appropriations level on the Space Station? If NASA initiates the design in FY 1985 under a "freeze", what impact will that have on other NASA programs?

Answer: If the FY 1985 budget were capped at the FY 1984 Space Station level of $14.0 million, there would be at least a one year slip in the start of all the front-end activities such as the Phase B systems definition contracts and the advanced technology work. This delay would greatly compromise the potential for international and commercial cooperative efforts on the Space Station. There would also be a significant delay in the initial operations of the Space Station. The scientific community would not be able to plan their activities with the capability of a Station in mind.

If the initial operation date of the early 1990's were maintained in order to minimize the external impacts even though initial funding was limited in the early years, the significant changes in the funding profile that would result could jeopardize the funding wedge now allocated for future NASA projects. The compromised funding schedule under this senerio would also have considerably higher risk due to the joint currency of activities.

Question: Mr. Beggs, you have stated that you are seeking international cooperation for Space Station development. If you are successful in getting, for example, $2 billion from international participation, will that reduce the $8 billion estimate to $6 billion?

Answer: The President has committed the United States to providing a permanently manned Space Station within a decade--independent of whether our friends and allies accept his invitation to participate in the program. I foresee that International government-to-government corporation will likely take place on elements which would be additive to the core capability of the $8 billion U.S. Space Station. If this were the case, foreign investment would not be expected to reduce the U.S. commitment to the baseline program.

Question: If we could assume that the Orbiters of the Shuttle fleet were modified for orbit time of a month and the fleet were argumented by free-flying platforms, what desired capabilities would still be required for a permanent manned Space Station?

Answer: Utilization of an extended duration orbiter (EDO) and automated platforms in lieu of a permanently manned Space Station would limit the missions that can be accomplished to those that can be fully automated and require only limited, intermittent cognitive and innovative capabilities of man. This would eliminate a large number of the manufacturing missions, primarily in the production area, and to a lesser degree, research and development missions. Research and Development and pilot manufacturing process verification will be limited to EDO duration. Life science missions will also be severely limited with no capability to supply long-term physiological data concerning the impact of extended weightlessness. The ability of manned interaction in "real-time" contingency operations, would also be lacking.

OFFICE OF TECHNOLOGY ASSESSMENT

STATEMENT OF MS. NANCY CARSON NAISMITH, PROGRAM MANAGER, OTA PROGRAM IN SCIENCE, TRANSPORTATION, AND INNOVATION

ACCOMPANIED BY DR. PHILIP CHANDLER, DEPUTY DIRECTOR, OTA CIVILIAN SPACE STATION ASSESSMENT

WORKSHOP ON AUTOMATION AND SPACE STATION

Senator GARN. Now we will transition to OTA.

Ms. Naismith and Dr. Chandler, it is a pleasure to have you here today representing Office of Technology Assessment.

As you know, Senator Huddleston and I, on behalf of the subcommittee, requested that OTA convene a 2-day workshop on automation and the space station. I wanted to capitalize on an ongoing OTA space station study to look at an issue that has, I believe, received too little attention to date. That issue is the extent to which the proposed space station will continue to propose areas that will be the next industrial revolution, robotics, artificial sensing, and artificial intelligence.

I appreciate your assisting the subcommittee by holding the workship, and please go ahead with your statement.

Ms. NAISMITH. Good morning, Senator.

I am Nancy Naismith, and I am the Program Manager for OTA's work in science, transportation, and innovation.

In our Office we are conducting the larger study on civilian space stations. It was a pleasure for us to work with the committee and give assistance by organizing the workshop held at OTA on March 18 and 19. This workshop provided an opportunity for experts to come together and compare automation research progress and objectives in the context of the space station.

We had 18 participants from academic, industrial, and Government research agencies. The projects directed by the participants ranged from the production of robots for repetitive manufacturing tasks to the study of artificial intelligence. All of the participants are engaged in work on the integration of sensory devices and information into larger sensing and operating systems.

LIST OF WORKSHOP PARTICIPANTS

I would like to submit a list of participants at the workshop for the hearing record.

Senator GARN. It will be included.

[The list follows:]

AUTOMATION AND SPACE WORKSHOP—MARCH 18-19, 1984

Dr. David Akin, professor
Department of Aeronautics and Astronautics
Massachusetts Institute of Technology
Cambridge, Mass.

Dr. James Albus, chief
Industrial Systems Division
National Bureau of Standards
Washington, DC

Dr. Michael Arbib
Department of Computers and Information Sciences
Graduate Research Center
University of Massachusetts
Amherst, Mass.

Dr. Ruzena Bajcsy, professor
Department of Computer and Information Sciences
Moore School of Electrical Engineering
University of Pennsylvania
Philadelphia, Pa.

Dr. Michael Brady, professor
Artificial Intelligence Laboratory
Massachusetts Institute of Technology
Cambridge, Mass.

Dr. Rodney Brooks, professor
Department of Computer Sciences
Stanford University
Stanford, Calif.

Dr. Margaret Eastwood
Vice president of engineering
GCA Corp.
Naperville, Ill.

Mr. Charles Fraser, chairman
Sea Pines Co.
Hilton Head, S.C.

Dr. William Isler, program manager
Systems Science Division, DARPA
Arlington, Va.

Dr. Steven Jacobson, professor
Department of Mechanical Engineering
University of Utah
Salt Lake City, Utah

Dr. Henry Lum, acting manager
Office of Computer Science and Electronics
National Aeronautics and Space Administration
Washington, DC

Dr. David Nitzan
Director, Robotics Department
SRI International
Menlo Park, Calif.

Dr. Marc Raibert, professor
Department of Computer Science
Carnegie-Mellon University
Pittsburgh, Pa.

Dr. Carl Ruoff, staff member
Jet Propulsion Laboratory,
Pasadena, Calif.

Dr. Roger Schapell, manager
Advanced Automation Technology
Denver Aerospace
Martin Marietta Corp.
Denver, Colo.

Dr. Thomas Sheridan, professor
Department of Mechanical Engineering
Massachusetts Institute of Technology
Cambridge, Mass.

Dr. Russell Taylor, manager
Robot System Technology, IBM
T.J. Watson Research Center
Yorktown Heights, N.Y.

Dr. James A. Van Allen, chairman
Department of Physics
University of Iowa
Iowa City, Iowa

Ms. NAISMITH. Thank you. We hope that the workshop and our testimony today will be of assistance to the subcommittee in defining the role that automation can play in the space station program and the ways in which the program can best be used to advance research in automation and thus contribute to the U.S. technological base.

Dr. Philip Chandler is the Deputy Director of our Civilian Space Station Assessment. He organized this workshop in cooperation with Dr. Thomas Sheridan of MIT, who served as chairman of the workshop panel. Dr. Chandler will summarize our present understanding of the use of automation in space based on our workshop.

Mr. CHANDLER. Thank you, Nancy.

Mr. Chairman, good morning.

IMPACT OF SPACE STATION

Any program to place substantial, essentially permanent infrastructure in orbit around the Earth will be a major, long-term undertaking. The importance of any space station will continue to be felt well into the 21st century—beginning with the next 10 to 15 years of its development and construction, and extending throughout the subsequent 20 to 30 years of its full operational use. Thus, the President's proposal that NASA be charged with developing a space station prompts the Congress to think and decide relatively quickly about a program, many of whose more important payoffs may not become evident for perhaps 20 years. As OTA has pointed out in recent testimony, any such program should be undertaken with appropriate long-term ends in view.

Although civilian space operations are too costly to be justified solely as a means for advancing the field of automation, they may, nevertheless, be undertaken in such a way that progress in automation is a concomitant of increasing our prowess in space capabilities more generally. Indeed, the space station program would provide perhaps a unique opportunity in which sufficient personnel and resources would be concentrated to provide a critical mass that could subtantially advance the state of the art in automation. But what are the realistic prospects for the study and exploitation of automation in space?

The workshop participants, all of whom have either expertise in one or more aspects of automation, substantial experience in working with space systems, or both, arrived at a general consensus of cautious optimism. This consensus may be summarized in the following five points:

CONSENSUS OF CAUTIOUS OPTIMISM SUMMARIZED

First, our present space activities simply would not be possible without automation. In order to monitor and remotely command and control many important in-space assets and activities, people on the Earth's surface or on the Shuttle rely on systems that are at least partially automated.

Second, more advanced automation has considerable potential to allow additional space tasks to be accomplished, but it cannot play a key role in any space station program of the 1990's unless its level of support is greatly increased and its uses clearly identified and broadly articulated. Research in the various fields of advanced automation—robotics, teleoperation, expert systems, and artificial intelligence—is moving forward, but it has not been given the national emphasis required to make it a significant contributor to space activities in the next decade. Researchers working on advanced tasks number only a few hundred, and the magnitude of NASA support for advanced R&D in this area falls into the range of $100,000 to $200,000 per contract or grant.

Third, interactive combinations of people and automated systems will expand indefinitely into the future, with automated systems becoming capable of more and more sophisticated tasks as time goes by.

Fourth, development of the capabilities to accomplish increasingly complex in-space tasks by means of advanced automation will benefit the entire range of automation disciplines. It is one area of space technology development that undoubtedly has spinoff potential for Earth applications.

Fifth and finally, the development of machine systems incorporating perception, motor skills, and artificial intelligence comparable to those of human beings requires so many breakthroughs that one cannot rationally predict when, or if, they will be available. However, many of the tasks envisioned for any space station could be performed at lower levels of automated capabilities, especially if human beings are remotely present.

From these points of consensus, it seems clear that both advanced automation and future space operations would be benefitted by more closely coupling them in any space station program. Thus, it does seem to make sense to use any space station program to drive R&D in automation, provided that objectives are carefully chosen and expectations for success are not placed unreasonably high.

MAJOR ISSUES

Three major issues emerged at the workshop: How best to push toward more capable automated space systems and the wider use thereof; how to determine the optimum division of responsibility between people and machines; and how to estimate the importance of space automation to Earth applications.

TOWARD AUTOMATED SPACE FACILITIES

First, toward automated space facilities. Provided that the environment is highly predictable and the activities are sufficiently circumscribed, there already are real opportunities for introducing useful automated equipment to accomplish some tasks and to do so relatively inexpensively. But, being able to cope with an unconstrained environment and a wide range of activities is well beyond the capabilities of currently foreseeable machines.

Automation, of course, is a dynamic field, and capabilities will increase over time. It is, therefore, important that the original architecture of any space station not preclude the addition of automated systems as they become available, a procedure, incidentally, not followed on the Shuttle. Especially since the technology is essentially frozen well before the actual hardware is flown, an incremental approach to the acquisition of space infrastructure might, with respect to the issue of incorporating automated systems, be preferable to acquiring an essentially complete operating capability all at one go.

Automating much of the ground support of any space station could be begun now. Other functions automatable in the near term are rendezvous and docking—tasks which the Soviets have accomplished in an automated mode for more than a decade—as well as scheduled maintenance and monitoring.

At this stage of the development of automated systems, it is important to pick some long-term goals well in advance of the state of the art, and to measure progress en route to that goal with a number of frequent real-world R&D milestones. One possible generic goal would be the demonstration of a robotic device capable of assessing an incompletely known situation, drawing upon its own knowledge base, communicating back to a human being on Earth or at another location in space for some advice, and, upon receipt of that advice, automatically implementing a complex repair or assembly task.

Specific R&D milestones for this generic goal would include the development of dextrous hands, flexible manipulators, and reliable three-dimension vision systems. It would be NASA's task to choose such goals and milestones as would be useful, both for future space systems and for ground applications.

PEOPLE AND MACHINES

Second, people and machines. The U.S. civilian space program has a history that is relevant to the development of long-term in-orbit infrastructure. In particular, there is a strong emphasis on manned space flight, and the expectation that people will be in space on the Shuttle for the foreseeable future. Given that reality, it makes sense to make the best use of human capabilities supported by automation.

Also, the maximum possible level of automation may not be the optimal level. Human beings have been found to be far more productive workers in space than had been generally expected.

On the other hand, there may be a tendency to rely too much on the human presence in order to avoid having to face and solve difficult technological problems.

In any case, this is not an either/or situation: innovative syntheses of the capabilities of highly trained people and sophisticated machines could be the rule for the predictable future. With the existence of high-quality sensors, manipulators, and communications, a human operator on the ground or in space could remotely perform many of the required space functions flexibly and adaptably. Further, through supervisory control, the human could communicate subtasks and conditional information to a robotic device which would implement those sub-tasks and quickly report back to the human when it had completed its task or ran into unforeseen difficulties. In other words, the machine could ask for help when necessary. Thus the speed, power, and precision of automation could be combined with the pattern recognition and judgmental qualities of the human being without paying the large cost of actual human presence. The appropriate mix of human and automated capabilities has to be determined on a case-by-case basis.

IMPORTANCE TO EARTH APPLICATIONS

Third, importance to Earth applications. NASA is a national resource, a technology driver for the whole Nation. International competition in automation technologies is a serious threat to U.S. commercial-industrial leadership. The space station program would be a good opportunity to help move our R&D efforts in automation onto a faster track. It has the additional advantage that there are no overriding institutional constraints; for example, that workers would be concerned about the loss of their jobs as a direct consequence of the effort, or that certain important technology demonstrations would be too costly in the context of terrestrial practice.

Currently, much of the research in artificial intelligence is being focused on near-term applications; similarly, the development of robotics is tightly constrained by the current requirements of Earth applications. The space station program could provide an R&D incentive to work on research topics that are at once truly advanced and germane to the real world. Possible R&D objectives could include a free-flying robot operating under supervisory control to service satellites, or an automated system to undertake hazardous tasks such as handling cryogenic fuels.

If automation R&D were seriously undertaken in connection with a space station program, the many tasks needed to operate the system could be analyzed to select several generic problems of clear relevance to Earth applications. These could include the development of dextrous fingers and hands, flexible manipulators, and advanced sensors, and especially the integration of real-time sensing data into the knowledge base of expert systems. In addition, new parallel hardware would be required to meet the weight and real-time constraints of space applications. All of these components are necessary to obtain truly flexible control in not wholly determined task environments such as are found in space—or in mining, shipbuilding, undersea work, construction, firefighting, and medicine—in contrast to those of the factory production line. Such a space program would present the opportunity to develop and demonstrate coordinated, integrated control over a wide variety of interacting systems.

Beyond these advantages would come the general development of more sophisticated knowledge and experiential bases in our scientific and engineering communities.

This completes my testimony, Mr. Chairman. Thank you.

Senator GARN. Thank you very much, Doctor.

DEGREE OF AUTOMATION POSSIBLE

In order to provide a frame of reference for the workshop, the subcommittee suggested that the participants review 10 functions that might be performed on a space station. For each of these functions the participants were asked to consider the higher level in which the following could be expected in the next 10 years. The obvious intent was to identify areas of where advanced and automated systems hold a promise for use on the space station and where technological limitations exist.

Could you describe the conclusions of the participants relative to the degree of automation that might be possible?

Mr. CHANDLER. Yes, Senator. The matrix represents the initial cut at how to think about the question of the degree to which these various space functions could be automated in the near term, as you said. The workshop did not attempt to arrive at precise quantitative answers, but to get a sense of where the state of the art lies with respect to each of the functions.

I will just say also that there is, of course, some overlap among the various functions. For example, satellite servicing, obviously, includes retrieval and docking, or at least rendezvous and docking as one of its elements. Also, I think that we might have done well to categorize the functions a bit differently. We might have put monitoring, for example, with controlling, rather than with troubleshooting.

Let me make a couple of general comments. First of all, it was generally agreed by the participants that the more predictable an activity, the more likely it is to be automatable in the near term and, consequently, the less predictable, the less likely it will be automated; and similarly, the more complex the interaction between the device and the environment, the more difficult it would be to automate it.

FUNCTIONS 1, 3, AND 7

So with those general points in view, let us start with functions 1, 3, and 7. Controlling—I also include monitoring in the sense of the housekeeping functions in the space station, its life support systems, the environmental control and stationkeeping—is No. 1. No. 3 is scheduled maintenance, and No. 7, retrieval and docking. Those are the least difficult to automate, and we should be able to come pretty close to getting those done within 10 years.

FUNCTIONS 5, 8, AND 10

The next group roughly include 5; that is, materials handling and transfers from the station, 8, assembly of large structures, and 10, production of materials in space were rated by the participants as roughly of intermediate difficulty. They would require at least telepresence and perhaps periodic human visitation.

FUNCTIONS 2, 4, 6, AND 9

Finally, No. 2, troubleshooting; No. 4, unscheduled maintenance; 6, sensing and communication, especially sensing; and 9, satellite repair, were judged to be the most difficult to automate because they involved the most unpredictability.

So I think that gives you at least a general sense.

Senator GARN. That category would be over in permanent human presence, then, you think, within 10 years?

Mr. CHANDLER. Those functions would require at least periodic human visitation and, perhaps, permanent human presence.

Senator GARN. What specific technical areas were identified as requiring additional research?

POTENTIAL SPINOFFS

Mr. CHANDLER. In the sense of spinoffs?

Senator GARN. Yes.

Mr. CHANDLER. What would be useful?

Well, let me address that question in terms of functional capabilities rather than specific devices that might be developed. If we could get robots which were able to respond to generic commands rather than individual programing steps for each particular motion that they were undertaking, each joint limb motion, that would have a great deal of importance for many Earth applications.

Along that line, if we had systems which could respond to such generic commands and could do so if they were addressed either verbally or by a simple command at a video display terminal or keyboard, or even by demonstration, that also would be very useful.

If we were able to develop systems which had sufficient artificial vision capability to distinguish unfamiliar objects in a field of known objects, that would also be useful in Earth applications. Another one would be the ability to integrate data received from various kinds of sensors—for example, vision sensors with touch sensors—and finally, I might just mention that if we had radical improvements in speed of motion, lifting ability, dexterity and control of applied force, those also would provide valuable spinoffs.

Senator GARN. Was there a general concern that NASA was not aggressively pursuing these areas in research?

Mr. CHANDLER. Yes; I think that would be fair to say.

Ms. NAISMITH. Certainly, a feeling that it could be profitably pursued much more aggressively.

Senator GARN. At the conclusion of the workshop, did you get the impression that more time could have been fruitfully spent discussing automation?

Mr. CHANDLER. Very definitely. Yes. It was quite a lot to do in a day and a half.

Senator GARN. Did you or any of the workshop participants feel that the lack of definition of what activities would take place on a space station or what functions man would would perform hampered the development of specific recommendations?

Mr. CHANDLER. Yes.

Senator GARN. Do you believe that an ongoing advisory committee focusing on automation could provide valuable assistance and insight into NASA on high technolog, space station applications?

Mr. CHANDLER. That would be a definite yes.

WORKSHOP PROCEEDINGS

Senator GARN. Could you submit for the record a copy of the proceedings of the workshop?

Mr. CHANDLER. Yes, we will do so.

Senator GARN. Thank you. It will appear following the conclusion of today's hearing.

I appreciate both of you, your willingness to be here today, and particularly the time and effort you put into developing the workshop. I would certainly agree that a day and a half or 2 days is not very long, and yet you know the difficulties of time and getting people together, but I think it is a very important subject of how we rationalize this in the future, of what man does and what automation does and how much we can push those frontiers.

Ms. NAISMITH. It was a pleasure for us.

Senator GARN. For us also. As I indicated in my speech on NASA earlier, that we keep their reputation going so that I can keep giving that speech every year.

Thank you very much.

Mr. CHANDLER. Thank you very much.

SUBCOMMITTEE RECESS

Senator GARN. The subcommittee will stand in recess until Thursday, April 5, at 10 a.m., at which time we will hear testimony from the Neighborhood Reinvestment Corporation, the National Credit Union Administration, the Department of Treasury, Office of Revenue Sharing, and New York City Loan Guarantee Program.

[Whereupon, at 11:30 a.m. Thursday, March 29, the subcommittee was recessed to reconvene on Thursday, April 5.]

[CLERK'S NOTE: The transcript of the 1½-day OTA workshop on automation follows:]

WORKSHOP ON AUTOMATED SPACE STATION

SPONSORED BY THE SUBCOMMITTEE ON HOUSING AND URBAN DEVELOPMENT-CERTAIN INDEPENDENT AGENCIES OF THE COMMITTEE ON APPROPRIATIONS, U.S. SENATE, WITH THE ASSISTANCE OF THE OFFICE OF TECHNOLOGY ASSESMENT

SUNDAY, MARCH 18, 1984

The workshop convened at 7:07 p.m., at the OTA Conference Center, Washington, D.C., Thomas Sheridan, Massachusetts Institute of Technology presiding.

Mr. CHANDLER. I am Phil Chandler from OTA. Let me thank all of you for coming.

All of us are expectant that this workshop will turn out to be quite useful. It is an opportunity for all of you to have some immediate input into the Senate's deliberations.

At the beginning here I would like to call on first Nancy Naismith from OTA, who is the Program Manager of the STI program, and then Wallace Berger who is a staffer from the Senate Appropriations Committee, and then our chairman, Thomas Sheridan, from MIT will begin the formal meeting. Thank you.

Ms. NAISMITH. I am Nancy Naismith. I am glad that you can be with us tonight and tomorrow. We appreciate your taking your Sunday evening and your Monday.

I would like to tell those of you who have not worked with OTA before that we appreciate your help. We are a small agency. We work directly for the Congress. Our job is to try to provide information to help the Congress. make complicated and difficult decisions involving technology. We do not tell them what to do, but we try to give them information so that the decision, when it is made, is the best possible decision. We try to draw together various points of view; a lot of diverse people are involved in assisting us in the study. But we try also to give actual information. As a Member of the Senate once said, "We can all have our own views, but we can't all have our own facts."

One of our jobs is to try to determine, if it can be determined, what is fact and what one might do with it.

Those of you who are from academia will probably have experience that is a little more like our work here than those of you who are from industry. Our studies tend to be something like a reference work. They take perhaps a year and a half. They are quite thorough and quite complete and intended to provide considerable depth. This particular workshop is a focused activity which is part of our larger work having to do with the study of a civilian space station.

I will be here for 2 days. I will be happy to answer any questions you might have on the work underway here. We have a very broad agenda. There may be other things you would like to know about or publications you might wish to have. We are pleased that you could join us.

OPENING REMARKS OF WALLACE BERGER, SENATE SUBCOMMITTEE ON HUD-INDEPENDENT AGENCIES

Mr. BERGER. Thank you, Nancy.

I would just like to say a few words to possibly set the tone and also to express our appreciation for your willingness to participate.

I think that these workshops in the past, and we have held several of them that have been very beneficial to us, and in that regard I would like to welcome you to the 2-day workshop on behalf of Senator Garn, who is chairman of the Appropriations subcommittee with responsibility for NASA, and on behalf of the entire Senate Appropriations Committee itself.

I think that we have an opportunity here to really encourage a free and open discourse between the best people that we could select, that we could find, the best minds of industry, university, and government. And I think one of the marvels of this process is that you are all free, which is a very nice side effect of it.

Mr. ARBIB. We usually charge. [Laughter.]

Mr. BERGER. I understand.

Mr. NITZAN. The bill is coming later.

Mr. BERGER. I am afraid so.

But I want to say, and this may sound trite, but I think this is really one of the great phenomena of our Government, the system that we function under, is that we can expect to involve in the decisionmaking process really the best minds that we have in the country. And we can call on them, the wisest people, the most knowledgeable, those with the most experience, the most creative people, and they can participate in the decisionmaking process.

I think that part of the reason for that is the fact that there is just such a natural tension between the Congress and the executive branch. And just part of our jobs, especially the jobs of the staffers, is to really look and very seriously question the kinds of policies and recommendations that are being made by agencies, Cabinet officers, and even the President, and to try to determine what the underlying assumptions of these policies are and what the ideologies underlying the policies are. And through that process to really illuminate the issues that we are talking about.

I think that that happens often in many types of government. The difference here is that in the States, unlike some of the parliamentary forms of government, the decisions are changed and the policies are changed as a result of congressional action. We wind up with a different kind of a preacher than was originally proposed.

I think that is very significant. I think we often overlook that in the day-to-day activities. That is kind of a miraculous system. I have always been impressed with it, the 8 years I have been on the committee.

We are going to pose and we have posed to OTA a series of questions that relate to this particular issue, a charge if you will, and the charge is kind of the opposite, the antithesis of what NASA has changed for the space station, and that is really asking what can be done without the permanent presence of man on orbit. What are the kinds of activities that can be performed and what is the consequence of this kind of a decision if that decision is made.

I think the reason we are doing that is that the focus of the subcommittee is not so much on the way things are done but what is done, how successfully it is done, and our focus is on permanent activity rather than permanent man presence, permanent space activity.

I think the subcommittee would judge the success of those permanent activities based on the merits of what is being performed and on the implications of what is being performed here on Earth, what are the spinoffs and what are the benefits that occur, and not on the manner in which they are performed. I think this is an important issue for us.

I just want to say in closing that this workshop is going to be taken very seriously by members of the subcommittee. I expect that a lot of the discussions, recommendations, and conclusions that are reached here, those especially that represent consensus opinions, will be used to structure the space station program from our perspective. It doesn't necessarily mean that is what the Congress will adopt, but it does mean our committee will rely very heavily on what you say.

I can assure you the Appropriations Committees are very pragmatic in their approach to things. We usually do not ask these kinds of questions idly. So with that, I bid you hello and turn it over to our chairman.

Mr. SHERIDAN. Thank you, Wally, and Nancy. You are both going to be with us for all of tomorrow?

Mr. BERGER. Yes.

Mr. SHERIDAN. My guess is there will be some questions about the role in all of this played by the Congress, and particularly the Senate Appropriations Committee. The latter, I suppose, is responsible for this meeting.

Let me just say that it is a pleasure to be in such good company. I am delighted that all of you could come. And I hope we can keep this meeting relatively informal and let whatever comes out come out and go on the record. However, Phil just dropped a note in front of me that says if anyone wants to speak off the record for any reason, he need only so preface his remarks. I guess at that point some bleeps will go onto the tape or the stenotypist will stop typing.

Now, Wally has already said it, but let me reiterate what I understand to be our mandate, our charter here. We are looking to the extent to which or the ways in which the NASA space station can be used as not only a transport vehicle but an institutional vehicle. Tom Rogers, from whom we will hear in a little while, uses the term "infrastructure," which I was quizzing him about before the dinner, to de-velop and demonstrate advanced automation. I presume that includes teleoperation capability.

Phil had some of the same words in his letter to us. The committee has given us an explicit objective to outline a scenario for an unmanned space station, and to develop that scenario until we find the limits of present and foreseeable automated capabilities, to specify the breakthroughs needed to overcome these limits, and to estimate how long it may take to overcome them, and to do it in 1 day, which we all know is totally impossible.

I presume unmanned means man not necessarily present but possibly on the ground doing things, and that is within the domain of unmanned as well as full automation.

Mr. BERGER. Not permanently present is perhaps another distinction.

Mr. SHERIDAN. OK, fair enough.

I understand that the output of our deliberations will take two forms. One is some testimony to the Senate Appropriations Committee, or its subcommittee, in a week or so, by Phil and/or someone else. And second is a report which will be put together by Phil and OTA staff and, hopefully, will be short.

I would make several quick observations on this. Then we are going to go around the room.

As I understand it, the space station configuration is far from fixed at this point in time. That is, it is more an infrastructure, and a possible design, than it is any particular design.

The second thing is that there is a skeptical public out there. We certainly are interested, I think, in Earth-based applications, spinoffs if you will. But at the same time we have to think hard about what advantage there is in doing whatever development is to be done in conjunction with the space station as compared to just doing it on Earth. In other words, why piggyback on the space station.

The second part of that is what might automation and/or teleoperations and so on save money in the actual space operations, the things that the space station presumably would be used for anyway, which if it were not automated would be done by astronauts.

My third point is, there is not only a skeptical public, there is a skeptical NASA, at least some parts of NASA, which—and who have to be convinced about the time it takes to implement certain kinds of automation, to make it work in space. That is to say the fact it works in the laboratory or even that it is commercially developed still doesn't make it flyable in space. Together with that is the question of flexibility. They will say people are more flexible, almost to any assertion you can make, and they will ask you questions about reliability as well as cost.

In discussing an agenda with Phil, it seemed to us that it was good to start out giving everybody some air time, going around the room. You can comment on the agenda—that is, if you don't like what you see in terms of what is planned for tonight and tomorrow, please tell us and maybe we will change. Second, give us a hint of your pet biases and projects and orientation.

One of the handouts was a matrix, I think you all saw that, which lists down the rows different functions that presumably are necessary to accomplish during the missions in space. On the columns were categories of fully autonomous, human telepresence, periodic human visitation and permanent human presence. These aren't necessarily mutually exclusive categories. I think there is a continuum between fully autonomous and human telepresence. But we can discuss that.

Our plan was to get into that tomorrow morning. As we go through it we would like to think about not only specific problems but specific capabilities that could be automated now or on the short term which presumably could be flown within 10 years. We also want to think about long-term R&D needs, which would automatically mean things that could not be done in the short term in space, as well as institutional arrangements that would be necessary to bring off these kinds of demonstrations.

So I guess I would urge you tonight to think about what you would have to contribute to this matrix. At the end of the exercise we would like to come off having some consensus on the matrix.

Later tomorrow, at lunch and in the early afternoon, we are going to force you to go off into groups and do some writing. It seemed best to do it that way rather than all holding hands around the big table.

Finally, at the end of the day, we want to test the consensus on some of these points and, at least in a rough way, formulate some testimony for next week.

So, with that, I would like simply to go around the room. Why don't we start with Dr. Isler here.

STATEMENT OF DR. WILLIAM ISLER, PROGRAM MANAGER, DEFENSE ADVANCE RESEARCH PROJECTS AGENCY

Mr. ISLER. I am Bill Isler from the Defense Advance Research Projects Agency. I am a program manager there in the area of robotics systems.

I think it is worthwhile to mention a little bit about my relationship to at least one of the other offices there. That is the Information and Techniques Office, out of which the Strategic Computing Office is managed. Bob Kahn is Director of that Office. They have essentially been funding quite a bit of research and artificial intelligence for the last 15, maybe 20 years. Accompanying that, they have three or four, maybe five, robotic research projects.

During fiscal year 1982, we decided that CARPA wanted to get more involved in robotics per se as opposed to AI research with the offshoot of robotics. So these activities were put into the Defense Sciences Office. The way we kind of distinguished between what Bob is doing and what we are doing, all of our research tasks involve some kind of sensory control of a mechanical device, hexacon walking work or the three-dimensional hopper Dr. Raibert is doing at Carnegie-Mellon or intelligence task automation projects that are managed in our division.

The part of those activities that overlap considerably what I think we want to talk about here has to do with the multisensory control aspect of it, in the sense we, too, are looking for platforms, machines, or robots that are adaptable, that can work as free as possible from human intervention.

So as you stated here, we have a continuum in whether it might be fully autonomous. Maybe that might mean yearly intervention or maybe every 6 months. We are also thinking about that.

The most ambitious effort we have going is one we are just starting. That is one of the applications for the strategic computing program. When I say "we," I mean my division. I am in the Defense Sciences Office, Systems Science Division.

As you know, there are three applications: Autonomous land vehicle, the policy assistance, and the battlefield management application. These will take roughly 10 percent of the funds associated with the computing program. The autonomous land vehicle has been assigned to my division under Dr. Kelly. He and I both will be working with that. We got that assignment primarily because we were already working in the area of vehicles. Even though we have a history of working with legged vehicles, the autonomous land vehicle associated with this program will not necessarily be a legged vehicle. It probably won't be because we plan to work with real vehicles.

One other point I would like to make before I quit, and that is I think one of the lessons we have learned or one of our approaches to this kind of thing is to, yes, pick this demonstration or this application that is way out there beyond the present state of the art but also pick fairly frequent milestones, demonstrations, along the way. That is sort of the heart of what we do.

I think in this kind of a program, yes, we need to decide what it is we want to do, why we need to do it without the man, but we also want to then define those technologies that are now preventing us from doing that, and also some milestones to give the taxpayers some confidence we are headed in the right direction.

Mr. SHERIDAN. Thank you.

Marc Raibert?

STATEMENT OF MARC RAIBERT, CARNEGIE-MELLON UNIVERSITY

Mr. RAIBERT. My name is Marc Raibert from Carnegie-Mellon University. Most of the research I do focuses on mobility in the form of walking machines that are dynamically balanced or stabilized, and also I do work on sensory control of manipulators.

One of the things that Tom mentioned in the opening remarks was the idea of flexibility, which I prefer to call versatility, in robots or in automation systems, and I guess I would like to talk about the issue of versatility sometime either tonight or tomorrow.

There is sort of a promise for space and for robots that you could have a system that was able to perform a variety of tasks. Then you could just send up one piece of robot and it could be used to do all of these things. The opposite extreme is to have fixed automation, one device for each different task and the payload, and, therefore, the cost in terms of kilograms of payload would be very high.

So there is sort of a dream out there that we could have a very few number of devices that could perform a whole variety of things.

However, if you look at how robots are used on Earth, that is typically not the case. A given robot installed in a factory, for example, does the same thing over and over again. It seems to me that kind of application in a space station would be limited. So if we are going to have robots that are versatile, some new work is going to have to be done. I think that is going to have to be a major thrust and something that NASA, whoever is responsible for this, is going to have to take on explicitly as opposed to relying on the kind of robot developments that is going on currently.

That is all I have to say.

Mr. SHERIDAN. Dick?

REMARKS OF DICK MALOW, HOUSE SUBCOMMITTEE ON HUD-INDEPENDENT AGENCIES

Mr. MALOW. My name is Dick Malow. I will pass at this point. I just would like to congrtulate Wally for putting together this group. The House Appropriations Committee is certainly going to use some of the product.

Mr. SHERIDAN. You are on the House side?

Mr. MALOW. That is correct.

Mr. ARBIB. Could you state your name, please?

Mr. MALOW. Dick Malow, House Appropriations.

We will be intereted in the results of the work and seeing what it produces, and undoubtedly we will make use of some of its implications in our forthcoming decision which we expect to be taking place sometime in the next 6 to 8 weeks. So I am more or less an observer, and I am interested in hearing what everybody says. With that, I will pass.

Mr. SHERIDAN. Margaret?

STATEMENT OF PEGGY EASTWOOD, GCA CORP.

Ms. EASTWOOD. I am Peggy Eastwood to the rest of the world.

I am Peggy Eastwood from GCA Corp. We are a company that builds and installs robots. So I think one of the things we should not overlook, although it is such fun to talk about the technologies, is some of the actual problems when you start about really developing the technologies to a standpoint where they are reliable because, obviously, when they are so far away, we are depending on the automation apparently to do many of these tasks. That includes things like fixing the satellites of the spacecraft, not fixing themselves.

One of the things I might point out is GCA has a very long history in nuclear power. We have a division called Par Systems, for anyone who happens to be in nuclear. We have been doing it for 25 years. There are some things that have become very apparent to us. It is a situation which is a small scale of what we are up against here. Certainly teleoperators have been very widely used there, and one might ask why is that? We could say that we all know that the technology isn't ready for totally autonomous work. That may be true. But the question is, at what point will it be? Because even in some of the nuclear operations it is quite repetitive tasks. Always change the fuel racks. Let's be careful of the examples. We have some that deal with armaments. There again is a very repetitive task. We still don't do it under autonomous control. We still have a person in the loop.

So there might be two things we might think of there. One is, is it technically feasible and is it desirable? Certainly reliability is something that is crucial. We have to be able to have our robots be able to fix themselves, which can be very difficult. We talk about redundant systems because you are telling them to go out and fix themselves before they go out and fix the other thing.

Another point I think Marc talked about somewhat is the diverse articulations or structures which might be necessary to do the wide variety of tasks we have here. Unfortunately, even again in relatively simple situations we don't have very many mobile robots yet, and we don't have many unusual articulations yet. So I think that as we postulate all of these things, and OTA, one of the papers that was sent to us in the mail indicated that there might be some reasons for you would want to get a lot of private industry to contribute to the cost. I don't know that that is our main goal, but if that were indeed a requirement, what would you have to do to structure this so you could get them to do it?

There are a lot of us that have never bothered to develop mobile robots because we didn't think General Motors would buy them or we didn't think company X needed them. So I think if indeed that is a requirement, it might influence some of the proposals that we might make from the technology standpoint.

STATEMENT OF RODNEY BROOKS, STANFORD UNIVERSITY

Mr. BROOKS. I am Rodney Brooks from Stanford University. My area of research is computervision, automating assembling operations, and mobile robots.

I see there are sort of three issues that were brought out as things we are thinking about. I want to talk about a few of the problems we might need to think about for robots for those issues.

The three issues are: One, how can we push a fully automated space station; two, what sort of split between automation and man in space operations; and three, can we use space as an area to push on robotics and thereby get a lot of spinoff for Earth-based operations.

With regard to the first, a fully automated space station, for some of the reasons that Peggy and Marc talked about, I don't think we conceive of that happening in the short term. So we have to talk about relying on a spectrum between telepresence and autonomous operations on the space station. We have to design for that spectrum and expect things would move along that spectrum over the years as we develop a better understanding of the problems as we go along.

For instance, suppose now we wanted to have an arm out in space and control it. Using full telepresence, we would be sending up joint coordinates, maybe with a master hand down on Earth to set up all the motions. Also, right now, today, we could design a system where we send out a few via points and let it have on-board control of its exact trajectory. So we would have a narrow band of communication.

Under laboratory conditions we could specify a final destination for the manipulator and use on-board sensors and cameras and use a date base about the space structure to decide how to move the arm. Later on we might say something like, "Remove the rack," and let the on-board system figure out that it has to move the arm and where it has to move it, et cetera. So there is that sort of spectrum of autonomy for the space station.

But at the same time we are going to have to be able to get in there and take over with telepresence from the Earth at any time because of fairly disastrous malfunctions where we would need to use our intelligence to do some very delicate operations to get things fixed and so we have to have redundancy.

So we need to design for that spectrum.

Second, we have to ask questions about what does the design process do. We will be designing a space structure, and we should take the opportunity to make use of whatever tools are used in the design for the space station to design data bases for the robots to have a complete model of what is in the space structure rather than trying to do that afterward.

Third, design coordination and methods of locomotion for robots in space. If we are going to have a very flexible robot, such as Marc talked about, which would give a complex task, it is probably going to have to move about. Methods of locomotion are different from on the ground. Probably you don't want to have it walking or rolling on wheels. There are issues of free-flying, whether it should be on rails, whether everything should be covered in Velcro. If we are always going to have people there, how do the human's requirements interact?

The last thing, what is unique about space and how could work by robots in space have spinoff on Earth. There is no gravity, very little, so it means the physics is different. When you put something down, it doesn't necessarily stay there. Without friction, small residual velocities out there move things about. Also, manipulators are liable to be very lightweight because of the cost of getting up there. So we are going to have nonrigid manipulators because they are so lightweight. So we will not have very good position control. We will rely more on force control. Then whether force control is plausible when building large space structures, and moving large beams around becomes a problem.

So this brings up the whole question about whether we can do development of robots for this environment without the need for large-scale experiments in space, much as we do lots of experiments on Earth now. How much can we do remotely here on Earth in an experimental basis and send it up and expect it to work? I think that is a question we might need to ask.

That is about all I want to say.

Mr. SHERIDAN. Roger Schapell.

STATEMENT OF ROGER SCHAPELL, MARTIN MARIETTA CORP., DENVER AEROSPACE

Mr. SCHAPELL. I am Roger Schapell with Martin Marietta Corp., Denver Aerospace. We are obviously quite interested in this subject because we have a vested interest in the space station itself.

The specific technologies that are going to be discussed here today and tomorrow are certainly those areas that we are very concerned with. We have a number of activities going now that should play into this and should certainly play into the discussion tomorrow.

For instance, we have been doing a lot of land-based physical simulation. For instance, the autonomous rendezvous, which certainly will be required. The reconfigurable ground control stations to evaluate how the human might interact with the system, or what the problems are as far as control modes and so forth. And under several contracts to NASA, we are working on the development of spacecraft services management, failure workaround, this sort of thing. Even though our emphasis is not on an unmanned space station, we are certainly trying to see just what levels of intelligence and sensory perception one might achieve.

I guess I do have a little problem with your matrix here on degree of autonomy. You know, we can automate anything. Well, we have done it with satellites and interplanetary spacecraft, and so forth, to varying degrees. The challenges are real in the degree of on-board intelligence one might achieve for the timeframe of interest. You know, we are talking 1990's. We have 3 years before we essentially freeze the technology. So that is really going to limit the degree of on-board intelligence in the perception.

The computer architectures, I think you heard a little about that from Bill Isler on that, that are going to be required, when you start employing these sensors, the intelligent planners and so forth, have a significant impact and it won't be business as usual. We don't have an airborne computer that will do the things we are going to be talking about here tonight and tomorrow.

Of course, another major area which Rodney mentioned was the simulation here on Earth, the modeling of the spacecraft structure. We still don't know just how good our models are or are going to be, even though we have flown planetary missions where we didn't know the constraints then either, but this is an even more complex problem in many ways.

At any rate, from within, we have seen the need to emphasize these technologies in order to bring the cost down in the future. You know, we built things like the CCMS, launch control and checkout systems, and they are very costly and man-intensive. Of course, the idea here is to minimize that sort of thing.

So I think the emphasis may possibly shift to the on-board intelligence and sensory perception and so forth. I am not sure automation is the right word for what we are trying to achieve.

Mr. SHERIDAN. I think we mean automation in the larger sense, certainly including those things.

Mr. SCHAPELL. Yes.

STATEMENT OF DAVID AKIN, SPACE SYSTEMS LAB, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Mr. AKIN. I am David Akin, faculty member of the Space Systems Lab at MIT. I was an investigator on the 2-year study for NASA Marshall on space applications of automation, robotics, and machine intelligence systems. I also lead a research group looking at manual and teleoperated space operations, particularly focusing a lot on large space structures and assembly.

We have several hundred hours of neutral buoyancy data base on human productivity. We have a functional neutral buoyancy version of a space teleoperator, designed to assemble the same structure under water we have assembled in manual (EVA) tests.

As far as point of view, I think I would like to caution against a blanket assumption that the level of automation we want in a space station is the maximum level you can reasonably achieve. We have done a lot of work in human productivity in EVA and have found that people are much more productive than anybody ever really imagined they could be. We found that with suitable training there is an instinctive adaptation to the neutral buoyancy simulation of space. We have had two-person crews working in neutral buoyancy assembling structures larger than the Space Shuttle in less than 2 hours.

I think with the great access of people to orbit provided by the Space Shuttle there will be a lot of unique tasks that will most profitably be done by a person, just because you may not want to spend the up-front money to develop a general purpose teleoperator robot that can do it if you can have people on site. So I think designing a total automated space station is not really that functional a thing to do. What you need is teleautomated servicers for the areas you can't reach for the space station; for example, geostationary satellite servicing. Something we based in the space station, could be possibly teleoperated from the space station, certainly maintained by the personnel from the manned space station, yet function autono-mously to do satellite servicing from the space station.

STATEMENT OF STEVEN JACOBSON, UNIVERSITY OF UTAH

Mr. JACOBSON. I am Steven Jacobson from the University of Utah. I am from a laboratory called the Center for Biomedical Design. We do a lot of medical developments, artificial kidneys, and things like that, and also are beginning working in some engineering areas, primarily related to manipulation. We developed the Utah manipulation arm and we have been working with MIT AI laboratories on the dextrous hand, which is a form of artificial manipulation, I guess.

We have a project related to actuators with DARPA. Actuators used for robotic purposes. Also, a nice project with Disneyworld to try to make automated figures look more natural than human life. By the way, I have some tapes here on the first finger of our hand. It is a high-performance finger. [Laughter.]

Also, an artificial arm, if anybody cares to see that at some point.

I have a number of biases about manipulations and dexterity and so on that comes from work with artificial limbs and dextrous hands. I am pessimistic, I think, about automating a lot of those processes. I think they allow the maximum use of people's cleverness of assembling and disassembling things.

REMARKS OF RANDOLPH WARE, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. WARE. I am with the OTA staff on the civilian space station study. I have a son, David, who is going to be 1 year old tomorrow. Last Wednesday this toy came in. It is called a space pet. It is a high-hopping humadorm. The timing was such I figured it arrived so I could show it to this audience here who hasn't seen this. I think in the center here would be the best place to show this, if I could move the table back.

Mr. ROGERS. Let me add that Randolph is a physicist, so it is all right. [Laughter.]

Mr. FRASER. You are out of business, Marc.

Mr. WARE. So this will be here for inspection if anybody wants to get a closer look.

Mr. SHERIDAN. Michael Arbib.

STATEMENT OF MICHAEL ARBIB, UNIVERSITY OF MASSACHUSETTS

Mr. ARBIB. I am Michael Arbib from the University of Massachusetts. I have two main projects, neural mechanisms of visuomotor coordination and a perceptual approach to robotics. What ties these together is trying to develop a schema theory as a high-level language for perceptual structures and distributed motor control.

I think that looking at the human brain and at robots together may actually turn out to be especially relevant to the design of man-machine interfacing. I have no experience at all with space stations. So what I want to do instead is to list some relevant research topics from my department which I think may impact some of our considerations.

First, we are designing new types of tactile sensors. It is clear that there are many inspection and assembly tasks in which such sensors will be important. In our machine vision project we have been particularly interested in designing highly parallel circuits for low-level visual processing—algorithms that can clobber a VAX 11/780 appear to be usable in real time if one has enough parallel circuitry. So I think that the funding of a program which will bring us to the state where these highly parallel systems can be put together at a reasonable cost will be a crucial part of the sort of intelligence we are talking about here.

A general theme that unifies much of our work is that of distributed computation. I distinguish distributed computation in which we have a number of processes doing different things by cooperating on global tasks from the parallel computation appropriate for low-level vision where we have many, many processes doing the same thing on a different piece of data.

In distributed problem solving, our current test-bed is vehicle monitoring where one has local nodes sensing information from different parts of a terrain. I could imagine that the same technology would be useful for distributed spacecraft control in which we are trying to give some local autonomy to navigation for different craft which have relatively low bandwidth to communicate with each other.

Another type of distributed computation is work on high-level vision where we are trying to integrate different knowledge sources. At the moment they are simulated on a single computer. We also study visual function in the brain, modeling the interaction of different brain regions, again gaining new insight into the way visual and motor mechanisms can communicate.

We are beginning to build networks of microprocessors for distributed control of complex robot manipulators. We look at an architecture where a task is spread over many different processes, each with their own functional area, but trying to factor in different processes. This may be an attractive architecture for space applications if we are worried about radiation damage knocking out some subsystems.

Again, in terms of reliability we are looking at adaptive methods for a variety of spatial learning tasks. Our AI group is also interested in natural language processes and expert systems, but I don't want to get into that here.

Let me close by stressing that in our robot research a central concern is the integrated on-line use of vision and touch in tactical level planning and control. What we want to understand is how we can interface this intermediate level of control with the more abstract AI approach to strategic level planning and with the more mathematical approach to the lowest level of adaptive and distributed control. The focus to date has been on assembly and inspection tasks, which are appropriate for functions centered on or within the space station.We think that many concepts, especially our work on optic flow—integrating visual activity over a period of time—are applicable here. This may be relevant in navigation in space and in EVA.

STATEMENT OF RUZENA BAJCSY, UNIVERSITY OF PENNSYLVANIA

Ms. BAJCSY. I am Ruzena Bajcsy from the University of Pennsylvania in Philadelphia. I am in the computer science department. I am heading a laboratory group of people who are interested in what we call active perception as opposed to passive, meaning that we use sensors for probing the environment.

The goal of that laboratory and the overall goal of my activities is to develop a household robot, in particular a kitchen robot. I don't like to clean the tables after a dinner party. I like to cook. So I would like to have a robot which will do that for me.

But this goal is sort of a motivational tool for doing the research of integration of a particular vision and other sensory information. When I thought about how my activities relate to the space program or the space station, I came to the following conclusion, and particularly they are a followup also of the third question Professor Brooks from Stanford posed, which is, what are the possible spinoffs of our work or how could we benefit from work in the wider space.

Here are the two possible avenues. One is that it is a trivial statement to say that obviously the physics of the world and space are very different from ours, as our distinguished physics colleagues will teach us. Hence, it seems to me that the sensors as well as the manipulators will be different than what they are on Earth.

For instance, just simply the fact that our manipulators sort of are force driven and have to counter the gravity, I don't believe we will really need hands or grabbing with the hands but, rather, I think that we will push because that is all that you will need. You need just the contact as opposed to a grabber.

So I feel that there are two things, at least two things that will benefit. One is that as we design automated factories in space, the objects for these factories should be designed completely different than they are designed for manufacturing on Earth because today they are designed for manipulating by people while there they are manipulated with robots. I think that will in turn, help us to also understand how to design objects for completely automated factories on Earth.

And the second thing is that I believe in order to process all of the sensory information in an interrelated fashion we have to have various ways how we represent knowledge and how we acquire knowledge.

Now this knowledge certainly represents the space and the physics we live in. It was mentioned the physics, the physics is going to be very different in space. Hence, this knowledge representation, although in principle could be in space the same, but the rules, the equations could be different. So I feel that the principles of this knowledge representation about space and physics could be interchangeable, though the input data will be different.

But lastly, and not least, let me put a little dream forward to you. That is that if we build the system, a robot system, which will be able to learn and assemble knowledge, then perhaps we have a unique opportunity to emulate in space what and how a system would have to go through in order to exist, in order to survive, if it would be in space. In other words, we will have a real test of emulating evolution in space. I say this not completely out of just fantasy. There is plenty of evidence that some of our processes, for instance, in our visual system, in biological systems, show some optimization process, for instance filters, and they evolved, at least we believe so, due to this selection, through the evolution. Hence, testing what survives in space may show us what are these laws and rules that help to force such a system to survive in space.

Mr. SHERIDAN. Thank you. Interesting.

Darrell?

Mr. BRANSCOME. I am Darrell Branscome with the House Science and Technology Committee, which is the House authorizing committee for NASA activity. I am here mostly to listen and learn. I think that the workshop will indeed be helpful to the committee as we ourselves review the design and the concepts for the space station and the appropriate balance between man and machine functions.

Mr. ERICKSON. I am from the Senate Budget Committee. I would like to echo Darrell's comments. I am struck by both the range of issues involved in discussing a space station, and by the seemingly unlimited opportunities as well. So I am mainly going to be a listener and benefit from the ideas that are presented this evening.

Mr. ARENZ. My name is Jim Arenz, Office of Technology Assessment. I am here to listen also. I am associated with the current space station program.

STATEMENT OF HENRY LUM, AMES RESEARCH CENTER, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. LUM. I am Henry Lum. My area of research is computer architectures. I am with NASA, Ames Research Center. I am currently detailed to NASA headquarters, where I am managing the Computer Science and Electronics Office.

The Office does have basic research going on in AI and teleoperation and robotics. The artificial intelligence is currently for the planetary efforts, but then it certainly has applications to the space station.

Our teleoperation and robotics effort is geared toward operation in the space station.

One of the chief problems that I see is really the transfer of the technology that you do for Earth-type applications into space. One of the problems that a lot of people don't realize is space does present certain constraints. For example, how do you deal with uncertainties? That problem translates into bigger computers and a much faster response time required in space which we don't really have right now.

The other problem we have is the control stabilities. In space, with lack of gravity, you are going to have a much tighter control problem which you don't have here on Earth. We also don't know how to model common sense and intuition, which if you had a completely autonomous system you would have to model that.

Again, that modeling does take up more computer time, more computer architecture speed, more memory. So there is a lot you can do with automation. However, I think the tradeoff is going to have to be, how much are you going to spend for that. There is certainly a cost and risk tradeoff. The more money you put into it, certainly you can automate more. But that may not be cost-effective.

I think this workshop will show there are some areas which can easily be automated, but then the automation will have to include evolving the technology.

STATEMENT OF RUSSELL TAYLOR, IBM

Mr. TAYLOR. I am Russ Taylor from IBM Research in Yorktown Heights. I work for a company that is really vitally interested in manufacturing technology and productivity. We certainly want to be the low-cost manufacturer of computers and other products. A result of that is we have focused quite a lot on gaining knowledge about key technology from manufacturing.

I manage a robotics research group at Yorktown. We believe that one of the keys to industrial productivity in the future will be the development of sensor-based programmable automation equipment that can be tied to factorycontrol systems and to the design data base, so that you can shorten the time required to develop and manufacture new products and so that you can use common equipment for a wide variety of purposes.

Now, it seems to me that robots and other programmable intelligent devices can be extremely effective in raising productivity, certainly on Earth, and also in a space station, where productivity of people will become extremely important.

However, I don't really think it is realistic, especially in the 1990's, to think that you can have a completely automated facility in space to replace a human presence there. I think Roger Schapell's point is correct. Even if you can do it eventually, you are certainly not going to get the technology in the next few years. Now in industrial applications where the environment is often very constrained we still rely on machine operators to get around problems that the programing did not anticipate. I think that for a long time to come you are going to have things that are going to require people in a space station environment.

I do think that the systems that will raise productivity are going to be important and that general-purpose devices are worth making serious efforts to develop for reasons that were stated in the handout and by some of the other people here. Typical areas for research and development are sensors, dexterity control methods, and programing.

I think it is especially important both to have programing systems that can work from computer models, as Rod alluded to, and systems that can be taught. You would like to have a programer's apprentice or a spaceman's apprentice, if you will, that you could rapidly teach a typical instance of a task and have the system repeat that task 50 or 100 times with subtle varying circumstances.

One final point and then I will stand down. There is quite a focus, I think maybe rightfully, on technology transfer. What would developing this kind of system do on Earth? I think there are two things.

First, the systems themselves. Intelligent semiautonomous machines would have wide use in maintenance activities on Earth. Road maintenance is one example. The Japanese are putting quite a lot of effort into developing this technology for Earth applications. Second, I think that the education of the engineers and the development of technology that can put this kind of automation into space, by itself may be the greatest benefit of this whole exercise. The engineers who develop this stuff will know how this kind of advanced technology works. And that is just incalculable.

That is all I have to say.

Mr. SHERIDAN. Thank you, Russell.

Carl?

STATEMENT OF CARL RUOFF, CAL TECH JET PROPULSION LABORATORY

Mr. RUOFF. I am Carl Ruoff with the Cal Tech Jet Propulsion Laboratory. We are partly funded by Henry Lum's office.

The group I represent does teleoperator work as well as robotic work. We are doing computervision and sensor-based control. Marc used to work with us at JPL. We did some good sensor-based control work. Then he moved to Carnegie-Mellon where things were a little less hectic sometimes, I think.

Also, I ought to mention we are working with the military at the current time trying to estimate what it will take to create highly autonomous vehicles. I have been thinking night and day for the past several months about how one creates an autonomous vehicle. We aren't really doing much real hardware and software work yet. It is mostly preliminary. We are thinking about what an autonomous vehicle is, for example, and what kind of resources is it going to take to do it.

That is an enormously complicated thing. The military environment is considerably different from an environment you would expect in space, for the reason that military environments are presumably actively trying to defeat you, a significant difference. On a space station, I think it is probably important, at least in the near term, to make the assumption that the environment is not actively trying to defeat you because that is going to improve things quite a bit; that is, not having to contend with hostile competition. Furthermore, it is helpful and reasonable to assume a fair degree of order in the space environment. When a shuttle mission is flown, for example, NASA does not take a forklift and dump shuttle pallets into the cargo bay. On the contrary, payload elements are well organized and constrained.

NASA uses an enormous amount of engineering and machine work to do what Henry Ford would have done with a snap fastener. With NASA it has to be space qualified. We have the problem that the whole world is watching and if we screw up, there may be great danger and a great deal of embarrassment. When the slip rings failed on

SEASAT, for example, everybody was watching. The director of JPL at that time had to tell some high-level people how we screwed up. That was not enjoyable.

So at any rate, trying to create an intelligent control system is enormously difficult. It is even difficult to comprehend in any detail what such a system is. As I mentioned, in space we won't have natural environments. They will be highly organized. When an asteroid comes through, that is a natural environment. A lot of the industrial automation available today can be extended usefully to work in space because of the high degree of organization.

Space structures, being quite fragile, tend to have funny control nodes. You don't just dock a space shuttle with a large structure, which, perhaps, has its own active control system, without the possibility of exciting destructive vibratory modes. It is not really going to be possible to perform such docking and control operations with direct teleoperators. It is difficult to convey to a human operator, in a sense the nervous system can easily assimilate what the behavior of the structure is, because we are not properly organized computationally.

On the other hand, we do know how to do control. If the system is architected in a reasonable way so control nodes and control regimes can be shifted readily on the basis of sensory input, it should be possible to stabilize a system and have it behave reasonably.

I think it is important to take a very pragmatic view of this autonomy we are talking about. These systems are going to be evolutionary. We need to make a pragmatically realizable first step. Things are going to evolve in response to what we do. It is also going to be very difficult to estimate now what our problems in 20 years will be.

I gave a presentation at the Army the other day on our study of autonomous vehicles. One member of the audience said, "Well, those things are so damned complicated, you can't fix them." Maybe that is true today, but the very fact that you are developing intelligent control technology means there is concomitant technology being developed which will allow us to address the maintenance issues. So it is unreasonable to state on the basis of the complexity of a single technology taken out of context, that maintenance will not be possible.

I have to say in response to Rod's comments, we are doing experiments in space. There is going to be a force control shuttle manipulator experiment flown within the next few years, but it will be teleoperated, and not autonomous, force control, which I am a little disappointed about. NASA has to be very conservative about that, as I mentioned above.

Finally, two last comments. I think relying totally upon man's activity in space may be a blind alley. I know there are a lot of high-level people in NASA that want things to be manned. These people tend to be pilots. I understand how people want to be in control. Performance often goes up, however, if you take people out of the loop. You don't have people hand-filing parts anymore. You have machines because they perform better. I don't think you should totally shortchange man, on the other hand, because, as we said, humans are very, very versatile. But in 500 years if we invest a lot in manned activity now, is that going to be as good a payoff compared to investing in machine intelligence technology?

The last comment concerns ways to make this workshop tractable. As I mentioned, I have been spending the last several months thinking, sometimes 20 hours a day, about what makes an autonomous machine. It is a very difficult issue. It is very hard to make other than an order of magnitude estimate about the cost. I would suggest we try to make some reasonable assumptions about the kind of global control architecture involved, define modular parts of that architecture, and use that information to focus the discussion. Otherwise, it would be easy for a workshop like this to end up simply talking about high-level things that can't be scrutinized very well.

Mr. SHERIDAN. Thanks, Carl.

STATEMENT OF JAMES A. VAN ALLEN, UNIVERSITY OF IOWA

Mr. VAN ALLEN. I have had a significant doubt as to my role in this workshop and this doubt has been strengthened during the past few minutes.

The grounds on which Phil [Chandler] persuaded me to participate are the following: I am a practitioner of space science and have been for many years. I have had a significant role in some 40 Earth satellite and planetary spacecraft missions and oversee one of the large university laboratories of space science. We have our instruments on seven currently active spacecraft and are preparing major instruments for three missions scheduled for launch during the next 2 years. The most remote of my currently active instruments is on Pioneer 10 of the Ames Research Center. This planetary/interplanetary spacecraft has been in flight 12 years, is nearly 3 billion miles from the Earth, and is providing data on a daily basis. During the course of its flight, ARC has sent some 10,000 commands to Pioneer 10, all of which have been acknowledged and executed. This is a rudimentary example of a robotic system. I am proud to be a part of it.

There is a question of what is meant by the term "unmanned space station." In my view, we have been operating unmanned space stations throughout the solar system for over 26 years. All of them have been man-tended from ground stations but none has been man-tended by direct physical contact. Perhaps this distinction is implicit in the term "unmanned space station."

In the context of this workshop, the space robotics that I have been engaged in are of a fairly simple nature. Examples are deployment of folding and telescoping booms, extension and retraction of antennae, removal of protective caps, changing modes of operation of electronic circuits, power switching, spinup and spindown of rotating spacecraft, reorientation of spacecraft axes, rotation of subsidiary instrument platforms, midcourse trajectory corrections, in-flight calibration of detectors, et cetera.

In this process, I have been a party to tens of thousands of successful commands to spacecraft. In most cases of long-lived spacecraft, and especially of planetary ones, the man-tending of the spacecraft by direct physical intervention is undesirable, unnecessary, and wholly impractical. It is with this background that I am deeply skeptical of the President's announced intention of emphasizing development of a manned space station within the next decade. My opinion is that there has not yet been identified any purpose—scientific or utilitarian—for such a station that is commensurate with the cost thereof.

One of my possible contributions to this workshop is to encourage rational discussion of this basic issue.

For example, the possibility of economically feasible processing of specialized materials in space is prominently cited by advocates of the space station. The most competent and dispassionate studies of this matter by the National Academy of Sciences are much more restrained in assessing this prospect, though favorable toward preliminary experimentation—hardly a ringing endorsement for a $20 billion undertaking.

There are many other matters of similar character. The proposed solar power satellite array was examined by a different group of the NAS several years ago and was given very low marks in terms of its economic feasibility, within at least this century.

The other skeptical comment that I have was made during a meeting of the Civilian Space Station Task Force at this table some 6 months ago. Mr. Fraser, of that group, emphasized robotics as a substitute for, or complement to, manned activities in space. I expressed the view then, and repeat it tonight, that regardless of the merits of robotics as developed at this meeting or elsewhere, there is a grave question as to whether NASA will sincerely and full-heartedly address such developments. NASA's devotion to the quasi-religious dogma of man's permanent presence in space is so deep-seated as to be immune to the rational discussion of alternatives.

Mr. SHERIDAN. You were wondering out loud why you were here. I thought you gave some pretty good reasons, and we are delighted.

Mr. VAN ALLEN. Thank you.

STATEMENT OF DAVID NITZAN, SRI INTERNATIONAL

Mr. NITZAN. I am David Nitzan, the director of the robotics department at SRI International. We have been working on robotics for the past 11 years, mostly trying to make machines intelligent by using sensors and computer controls to emulate perception and cognition.

Our main research efforts today are in developing techniques for robotics, primarily three-dimensional vision, using visual and range data; sensor control manipulation, using sensory feedback; and automatic planning for manufacturing processes. We also have another thrust, which is applications such as printed circuit board inspection and visually guided arc-welding robot. We are currently getting into more robotics areas.

The basic problems that we are struggling against on Earth will also be in space. However, there are some differences and they were very well documented in the papers we received. I think the matrix is very well thought out. I have some questions about some definitions here, but that is not important. I have some points to make relative to the issues we are talking about.

The advantages of automation in outer space were stated in the paper—there are jobs, such as making better crystals or glass, that can be done better in outer space. I am not an expert in these processes, and I assume that they exist. So that is an advantage.

But there are other points which were not mentioned, such as the increase in quality that results from the repeatability of manipulators and robots. Another incentive for automating outer space manufacturing is that the cost of bringing astronauts up there is very high, even if all they have to do is go up and come down. In addition, there is a cost proportionate to the duration they are in the space station. The safety of the astronauts is very costly because they are watched by everybody. So you pump much more money than is normally allocated to save ordinary people.

But there are limitations, too. Perception today is better done by people. Hopefully, in 20 years machines will be able to compete very well with people.

Another issue, which was not mentioned in the paper, is how to optimize a team consisting of man and machine so that man does his best, or her best, and machine does its best.

The other issue is the uniqueness of the R&D issues in space. Why do we desire to perform experiments in outer space to advance general robotics?

Finally, I would like to also talk about the configuration of the effectors in the space station laboratory or manufacturing facility. There is the question that some people raised—maybe Marc—about how structured that system should be. For example, would the robots be able to float around in a flexible, unstructured environment, or would they be forced to go on rails, which is easier to automate?

Then there is the question about end effectiveness. I am not sure we don't need grippers, Ruzena, because if, for example, you go in a straight line, maybe you can push it. But if you go in an arc, to prevent floating and going anywhere in the environment there, you have to grip it. But the question is, what are the tools?

I think with that I will just pass it on.

STATEMENT OF JAMES ALBUS, NATIONAL BUREAU OF STANDARDS

Mr. ALBUS. I am Jim Albus from the National Bureau of Standards. At NBS we are in the process of building what we call an automated manufacturing research facility (AMRF) which will be a full-scale machine shop completely operated by robots and computers. We don't even intend to use teleoperators except as a way of teaching robots how to do complex and difficult tasks.

Our goal in this facility is to have robots that will be able to visually point to find, pick up, inspect, clean and deburr metal parts, insert them in clamps and fixtures so they can be machined. Work station controllers will coordinate the activities of the robots and machine tools to do a variety of milling, drilling, boring, tapping, and turning operations. We intend to make extremely complex aerospace parts.

Now, we think we know how to make the robots able to build fixtures so as to hold the parts, to set and release the clamping mechanisms, to assemble and measure the tooling, and to monitor the machine operations so they know the parts are being made correctly as they are being made, or to correct defects before they become uncorrectable.

Our AMRF facility will be controlled by higher level controllers which will plan and manage the scheduling and delivering of parts and tools so they arrive at the correct place at the correct time for the correct operation.

Furthermore, the entire system will be data driven from knowledge of the geometrical shape and the dimensions of parts and tools. This information will be combined in a world model with input from sensors so the automated shop will be able to manufacture a wide variety of parts without requiring changes to be made in the control programs.

Now, our experience so far in building this AMRF facility makes me optimistic that we will be able to demonstrate all these capabilities and have a completely operational automated machine shop well before the end of this decade. So I am going to give a slightly more optimistic viewpoint than I have heard about the table tonight.

I am perfectly confident that if NASA were to spend anywhere near as much on robotics (and teleoperator) technology as they have, and are going to spend on life support technology for astronauts, then an unmanned space station could be built and flown.

However, I don't necessarily believe that would be a good thing. I don't believe that a totally unmanned space station would be, in the long run, in the interest of the country, or even of the robotics community itself. The reason is that a completely unmanned space station, operated by robots, would reinforce the unfortunate but popular misconception that robots are going to put everyone out of work. For if robots can put even astronauts out of work, what hope is there for the rest of us.

My feeling is that the space station should be a place where robots and humans work together. Where they share the same space, and together are able to accomplish what neither could do alone.

I think we should address the scenario where robots and humans cohabit the space station. Where intelligent manipulators, both inside and outside the space station, can be operated in either the robotic or teleoperator mode.

There is, by the way, an entire hierarchy of control modes in which a manipulator can be operated. At the lowest level, each joint of the manipulator can be individually controlled by individual switches, or by a master-slave arrangement. At a higher level, the position, orientation, and trajectory of the manipulator endpoint can be controlled; for example, with resolved motion rate control. At a higher level, elemental movements such as reach to a point, grasp an object, move, release, et cetera, can be commanded under supervisory control. At a higher level, the robot can be commanded to perform simple tasks such as load part A in fixture B, or insert tab C in slot D. At higher levels still, a robot can be commanded to build assembly X from a kit of parts, or perform machining operations XYZ on a group of parts. At a still higher level, robots can be integrated into manufacturing or assembly systems so that their operations are coordinated with other machines and other robots.

If the control system is properly designed, it will permit human input at any of these levels. I have a set of publications here that describe in more detail how such a hierarchial control system can be designed.

The types of tasks that robots/teleoperators might accomplish, both inside and outside the space station, are:

One. Teleoperators should allow ground-based experimenters to perform hands-on experimental work in the space station, or outside it.

Two. Outside the space station, construction inspection and repair robots and teleoperators will be able to do strenuous and hazardous activities, either under ground control, or under the supervision of astronauts inside the space station.

Three. Robots inside the space station should be able to perform routine manufacturing and experimental operations, such as loading and unloading furnaces, storing tools and materials, and performing simple manipulatory tasks. I think they should be capable of acting as helpers, or "gophers," if you will, for the astronauts using voice input and output.

Robots to the space station might also perform routine housekeeping tasks—vacuuming, preparing meals, cleaning bathrooms, washing dishes and floors, and even doing windows. [Laughter.]

It is going to cost somewhere between $10,000 and $100,000 an hour to keep an astronaut on station. It certainly makes no sense to spend that kind of money for the astronaut to do cleaning and cooking services.

But more important than the cost savings, I think that by developing domestic robots for the space station, NASA would get credit for an economic spinoff that every housewife—and househusband—in the country is looking forward to. Housewives really seem to be the only class of workers I have ever come across that have no fear of unemployment because of robots. [Laughter.]

And the development of domestic robots for the space station, I believe, could become one of the most popular things NASA has done in a long time.

Of course, real practical spinoffs will come sooner in the industrial environment. In order to put not one but a whole team of robots in and around the space station, we are going to have to have many new developments in structures and dynamics, modeling, programing, learning, as well as systems architecture and interfaces. These technological advances will have as many applications on Earth as they do in space. They could be used not only in factories but in construction sites, shipyards, in mines, in ocean floor operations, on the battlefields, in the home, and many other places.

I think the economic payoff in these areas will at least justify the investment in robots for the space station and, perhaps, many times over. But even more important, I think, will be the psychological payoff of demonstrating in a most dramatic way that humans don't need to feel threatened by robots. Because robots can and should be, and in the space station if they work together with humans, will be good companions and faithful servants. That, I believe, is a view of advanced automation that would serve us all well.

Mr. SHERIDAN. Thank you, Jim.

Nancy, I guess we have already heard from you.

Before we hear from Jim Andelin and Tom Rogers, why don't we go down the back row there briefly. You don't have the benefit of nameplates.

REMARKS OF MARSHALL SPACE FLIGHT CENTER

Mr. POWELL. Luther Powell from Marshall Space Flight Center, detailed to NASA headquarters for a year. I have been heading the Concept Development Group here on the space station task force. Our responsibility was to develop the concept of a space station, or concepts, which fit within Tom's definition of infrastructure, to make an estimate of the cost of the space station. We also have been examining critically the feasibility of taking those concepts to fruition and identifying the major technical issues associated with development of a space station.

Mr. SHERIDAN. Will you be here tomorrow?

Mr. POWELL. Part of the day. I have to leave in the afternoon.

Mr. SHERIDAN. OK. Because we may want to ask you a question or two along the way.

Mr. POWELL. All right. I will be happy to be here.

Ms. KERWIN. Mary D. Kerwin, NASA Legislative Affairs.

STATEMENT OF DAN HERMAN, SPACE STATION TASK FORCE

Mr. HERMAN. Dan Herman, on the Space Station Task Force.

With the chairman's permission, I would like to speak for about 5 minutes.

Mr. SHERIDAN. OK. Can you keep it to five?

Mr. HERMAN. Yes; I will.

The position on the space station within NASA is that we would still want a permanent presence of man in space, even if it could be proven that functionally everything conceived of today could be done by robots.

The reason is that we think it is NASA's charter to essentially prepare for the exploration of space by man in the 21st century. At the very minimum, what that demands now is the conduct of life science experiments which will allow us to really understand the physiological aspects involved in such exploration.

Jim Van Allen and I have had a friendly debate on this issue for about 10 or 15 years. One thing we will agree upon is that a vital factor in the selling of the Voyager program is that Voyager had a high exploration content. There were segments of the scientific community that strongly believed that the Voyager program was too costly for the agency content. NASA, however, is in the job of exploration as well as conducting sheer science.

It is my belief, based on my experience, that the very crucial science performed by Voyager was accomplished because it was coupled to the exploration ethic. The exploration ethic will be fulfilled with a manned space station as well as with unmanned systems.

As a matter of fact, there are quite a few scientists who believe this and have gone on record to that effect. There was a recent article in the Stanford Observer by Peter Banks in which he states that a space station cannot be justified sheerly on scientific grounds.

The space station cannot be justified solely on a cost-benefit basis. The exploration potential, and the cultural inheritance, that are coupled to the expansion of man's domain, are the vital elements in the decision to proceed with a space station. The rationale for developing the space station is the unknown future yield that will be derived by laying the groundwork for man to work routinely in space, accomplishing functions and undertaking endevors that cannot be formulated and crystallized right now.

Because we will be unable to have the complement of men in space necessary to accomplish all the space station functions, with limited onboard manpower, we must really push the potential of expert systems, robotics, and telepresence. I really think the issue is the optimum partitioning of functions between man and machine rather than automation versus manned participation.

One of the people I have discussed this issue with recently is Dr. Robert Frosch, vice president of General Motors Research Labs. He gave a paper at Princeton University 5 months ago where he stated that there are two extremes which are not reasonable. One extreme is that you select astronauts by picking the best and brightest people in this country. We train these people intensively for 2 years. And then do we have these trained experts turn a screwdriver? He thinks this strategy is asinine. He also thinks it is irrational to assume that all vital functions can be performed without the real-time intervention or interaction with men.

I guess from a personal standpoint, I would urge the group to come to grips with the issue of how we can push this very important technology area and at the same time understand NASA's position that there will be a permanent presence of man, completely decoupled from the functional issue. That is the NASA position; I have attempted to state it in my own terms. I am sure it will not be vocalized in the same manner by Mr. Beggs or any other NASA official.

Mr. SHERIDAN. Thanks, Dan.

Mr. PIKUS. Irwin Pikus, with the National Science Foundation. I have been doing some informal consulting with the OTA assessment team. I have no preconceptions I will admit to. [Laughter.]

Mr. DRAY. Jim Dray, OTA. I have been working on a study of factory automation systems.

Mr. SHERIDAN. Thank you.

Wally, did you want to say another word?

COMMENTS OF WALLACE BERGER

Mr. BERGER. Yes; just a word or two about the committee's motivation in getting into this business.

I think first of all—let me back up for a minute. The first thing that struck us, of course, during this whole proposal stage of the space station is the magnitude of the project. This is a very, very large project. Whether you use the $8 billion estimate or the $20 billion estimate, it is a very significant project in terms of a new initiative in the Government. It is potentially a high-technology project.

Because of those two factors, we felt that it was worth while at this point to explore whether, given that critical mass of personnel and money we are going to have involved in the space station, whether it would not be appropriate to focus that on advancing the state of the art in a variety of technologies. I think that we were somewhat surprised, I personally was surprised, that the space station seems to be proceeding along the course where there are no technological show-stoppers. In other words, the technology is basically in place. There are no, as far as I have been told, real long pulls that would stop this effort from going ahead and having six to eight men in space.

To me, that is a serious statement, because we look at NASA and we look at the space program for more than that. We look at the space program as a method of, in fact, being a technological driver in this society and developing techniques that are not there. This is in addition to what Dan has said, whether one agrees or does not agree with the manned component of the mission, we still, of course, look to NASA for the spinoffs.

I think there are concerns that have been raised around the table about the parallelism between what we do on Earth and what the space environment is like. I think many of those concerns are based on the differences in physics in the environment. But I think when we look at the technologies that we are talking about, the technologies are not mechanical/physical based. We are really talking about advances in the technology in the software areas, the areas of sensing, artificial intelligence. These are basically blind to whether it is zero G or whether you have weightlessness or whether you have a vacuum. We are talking about conceptual advancements in these areas. I think those are fundamental and will have obvious implications back here on Earth.

I think the issue of autonomy and the continuum that has been laid out in the matrix, the four columns, is one that we feel should be considered very seriously, each step in there. The committee has not proposed at any time during its deliberations that there should be an automated station in the sense that one would normally define automation. There obviously is a need for some human intervention, whether it be in the loop on the ground, in the station, periodic visitations, and so forth.

I think that that issue has been brought up as a strawman in many of the arguments. Obviously we are not going to have a completely autonomous space station. In fact, if we could have one, it probably would not be worth creating because we don't want to have an interaction in order to accommodate legitimate questions that people have about what is going on in the station.

I think the other issue that was raised around the table, which is also related to the motivation of the committee, has to do with when the technology has to be frozen for us to proceed. There are several ways of looking at that. I think one way is to assume that there is some manifest destiny in getting there some 500 years after Columbus and that ought to drive the entire effort. The other way of looking at it is to try to determine what technologies are available and what missions fit those technologies. You develop then an evolutionary concept of a space station that is designed around the ability to accommodate those missions at some point in time. As the technology matures, then the mission set would change accordingly to keep up with it.

I guess what I am saying is I am not trying to dissuade anybody of their opinions, but what I am saying is I think we are trying to take a much more flexible view to this subject than some of the constraints and assumptions that have been put on it by either the administration or some of the people that you have read about. We are not assuming that IOC is 1992, that that is when the space station has to be up and operating on all 107 missions. I just wanted to clarify a few of those issues.

Thank you, Tom.

Mr. SHERIDAN. Thank you, Wally.

I guess our plan is to have Tom Rogers, who is the Director of the OTA space station project, go next.

Tom?

STATEMENT OF TOM ROGERS, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. ROGERS. It is late. Let me make two very quick and specific comments about things I have heard.

First, if there is any characteristic of the space activities of this country, it is that they cost like hell. Therefore, when you say because it costs so much, thousands of dollars per pound, to put things in orbit, we should, perhaps, be quite interested in reducing their mass.

Well, we should be careful. We are talking about long-term assets here now, not expendables. So when you can put 20 to 30 years into the cost denominator, if it costs you in development terms, or if it costs you in your confidence of reliability, to take mass out, that may be going in the wrong direction.

Second, the best suggestion I heard tonight—and I hope it was a serious suggestion—was, let's get to using "forklifts" to put equipment into the Shuttle Orbiter. If we could focus a little bit on Earth activities as well as space, and automate them, there is a potential savings of several times $100 million a year. If there is anybody here from the business world, they might take that thought home with them.

I am going to do two things in short order. One, to stand back and look at the forest a little bit, to talk about how we got here from there.

Second, particularly taking advantage of Luther Powell's and Dan Herman's presence here, to talk a bit about what people imagine or desire should be going on up there being supported by the infrastructure, so that we all can start out tomorrow morning with a better sense of what it is that people want to do there so you will have a better sense of what makes more sense to think about regarding putting sophisticated machinery to work there.

Measured from the launch of the Sputnik, we are well into the second quarter of the space age. So far we have spent over $200 billion, 1984 adjusted, in our publicly supported civilian space program. The initial era of great ignorance about the Earth's near space and great uncertainty, indeed fear, of being there, and putting things there, and the use of very conservative and, therefore, very expensive technology, that era is beginning to be left now. We now are able consistently, and with confidence, and with a great deal of knowledge, to get up there, stay there, survive there, function there, do things there, and come on back safely.

Indeed, the United States of America now is capable of doing essentially anything it wishes to do that is rational in the Earth's near space.

The question is, what to do? Let's recall the previous great decisions in the space era. The first one, that we oftentimes forget, is that a decision was made a quarter of a century ago, approximately, to have a large, vibrant civilian as well as a military space program. The second was a decision to put a man on the Moon and bring him back alive, safely. Both decisions reflected, as much as anything else, national security considerations.

The third great decision, in retrospect, was to create a private satellite communications industry, reflecting economic considerations.

And, throughout, was the decision to study and explore the bodies of the solar system, and to use space to conduct, from there, scientific experiments.

Almost without notice, the character of this publicly supported space program changed about the year 1970. While the general public has continued to have a modest continuing interest in space and has supported its publicly funded space program magnificently, it does not truly involve itself in any important fashion in the selection of the objectives of this program. It simply does not rank in interest or concern with housing, education, agriculture, national security, health service delivery, and so on. And so, in a form of what some might chose to describe as a kind of benign neglect, the general public has left the objectives to be sought in our publicly funded space program to the hands and the imaginations and the skills of scientists, engineers, and their managers in government, in concert with others in our space industry and our universities.

Most of these people are engineers.

Now I am one myself and some of my best friends are. In describing engineers, generally, you would not say that they are the most imaginative, emotionally charged people in the world. They are, indeed, at times described in terms of conservatism.

Consequently, for the last 15 years or so, the bulk of our civilian space expenditures have been in the creation and in the acquisition of space-related infrastructure—launch sites, rockets, global monitoring, communications and rescue services. And the most recent major program decisions—apart from the Space Telescope—were to develop more infrastructure, the Shuttle, and the Spacelab.

The U.S. Government engineers, looking ahead to the satisfactory completion of the Shuttle program, and its freeing up of thousands of engineers, and perhaps as much as $2 billion a year if their present appropriation level is maintained, have now opted for another large addition to our space-related infrastructure, to be concentrated in the Earth's lower space.

With the President's approval, the Congress and the public are now debating whether or not to take another momentous step. That is, to commit the United States, as has the Soviet Union, to the long-term considered development of space.

Let me give you an analogy. It is as though we had considering the development of a large element of remote raw land. We know the location: certain preferred orbits. There is a legal structure to protect it: we have the outer space treaties. We can get there and back: we have transportation with the Shuttle. We can communicate with it: we have the TDRSS.

We are now, perforce, asking ourselves some very basic questions about this next large commitment, a long-term commitment, to the placing of infrastructure in the Earth's lower space regions. We are asking ourselves now who should develop it, who should pay for it, who should own it, operate it, use it, and even if we have it at all. And, of course, underneath everything else, again, who should pay for its great cost.

Tonight and tomorrow we are going to concentrate on one aspect of this infrastructure: its incorporation of "smart machinery." We are not going to speak, except at the margin, of men and women being there to work or to conduct cultural activities. It was Wally's desire to concentrate primarily upon the use of sophisticated machinery there, and then fall back from this position and talk about having people there in lieu of, or in parallel with, smart machinery as circumstances would seem to require.

So now I am going to the basic elements of such infrastructure that have received the most attention by the most people.

I would like to make one very important observation about what we are talking about when we use the expression "space station." We are talking about infrastructure. We are talking about assets and services laid in to support the addressing of objective ends, however defined.

Infrastructure is there to provide support to the conduct of activities. It is not an end in itself. It might be an institutional end for those concerned with its acquisition, but fundamentally it is simply a stepping stone toward the addressing of objective ends.

What do we now see being aspired to in the use of such infrastructure?

An on-orbit laboratory for studying life sciences: plants, other animals, human beings; physiological, psychological, and social. If we indeed aspire to have our people reside in and travel over great distances and great times, there are a lot of things that we don't know about that we will have to find out; for materials sciences; for the development and first test or use of new technology to support various scientific experiments.

Second, on-orbit observatories, looking outward for astrophysics, solar physics, and astronomy, and looking inward and down for Earth sciences and Earth resources observation—looking at matters of interest in agriculture, mineral exploration, urban planning, fishing, and so on.

Third, materials processing and, hopefully, materials manufacturing: pharmaceuticals, electronics materials, high-purity glass products.

Fourth, the servicing of nearby and remote satellites and spacecraft: their repair, component replacement, replenishment of consumables, and so on, and the basing and operation of orbital maneuvering vehicles used to do so.

Five, a transportation hub to assemble, check out, and launch satellites to geostationary orbit or other high orbits and space probes for farther on out. And the basing for reusable orbit transfer vehicles to launch, service, and retrieve satellites in distant orbits and, with further development, to enable establishment of human settlements on other bodies of our solar system.

Next to last, storage of fuel, materials, and supplies on orbit to be available to be used as needed, in situ and for satellites and space vehicles.

Last, assembly of large and/or complex structures to enable new and more efficient uses of space; the ones first thought of are in communications or in very novel research and production facilities.

In general, these are the sorts of things that people think seriously about doing in space and that some believe can be done more effectively and/or more efficiently if there were the proper character and amount of infrastructure available over the long term in the Earth's lower space.

Just before leaving my residence this afternoon, I got around to reading yesterday's mail and I found that—I am a fellow in the IEEE—I had received a journal called "The Institution." There is a paper therein by Phil Culbertson, who is the No. 3 man at NASA. The general title of it is, "A Balance of Man and Machine in the Space Station Area." Even if Dan Herman didn't write it, it probably reflects his views. Our technology is down tonight; tomorrow, when it is up, we will make copies of this paper and give them to you.

I am very pleased to have Dan and Luther here tonight and a good part of tomorrow so as questions occur to you about the real need for some of these things they will be able to respond. Thank you.

Mr. SHERIDAN. Thank you, Tom.

You are going to be with us all day tomorrow?

Mr. ROGERS. Well, close by and on call.

Mr. SHERIDAN. OK. Good.

Mr. ROGERS. I will be looking for that forklift tomorrow, too.

Mr. SHERIDAN. Does anybody have a burning question they would like to put to Tom right at this point?

I guess we can get back to him tomorrow.

I don't want to prolong the discussion too long tonight. Let's hear from John Andelin. I am not sure if it is a benediction at this point. Tell us something about OTA.

STATEMENT OF JOHN ANDELIN, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. ANDELIN. I am John Andelin, Assistant Director here. I guess I have only a couple of comments on this activity in the Congress. One is that it is remarkable that so many congressional staff have joined us this evening. I think it speaks to their own dedication and concern over the problem.

Tom Rogers alluded to the fact that it is a very expensive program. Of those here that I have spoken to and those that weren't able to join us tonight with whom I have spoken, a very clear concern is that, the activity being a large one, it be used for appropriate long-term ends. I think that is what we heard throughout the evening.

One other comment I would like to make about the Congress and its decisionmaking is that it is very easy to agree on grand principles as long as you keep them at a high enough level, whether it is good health or effective use of resources or exploration of the solar system. And there are other occasions when you are lucky that you can get people who might see those end points a little different to agree on the first step. That is what often takes place with our annual process of agreeing on a first step. The real trick, and I think what we are trying to accomplish here, is to take those broad we-all-agree-on statements and some of the first steps we all agree on and be able to carry those first steps a few farther down the line so that by the time the camel is all the way in the tent, everybody likes it and all agree that is, in fact, the purpose of the tent and the reason they wanted the camel to start coming in the tent.

We are trying to look at a program that is going to have its impact felt for a generation from now, for the next 5 or 10 or 15 years of major construction, and another 10 or 20 years thereafter of use. I think we have all heard of it as a program that, whatever form it takes at the beginning, will continue to develop and even evolve thereafter.

So the Congress is being put in a position of having to think quickly on an issue that is going to come forth in full splendor over 20 or 30 years. The kind of time and expertise you have chosen to give us Sunday evening, some of your weekend, too, we hope—and from our own experience in the past we can say—will really make a difference to where this program is going to go.

So I would like to thank you on behalf of OTA for coming. I think we will all be available here and/or tomorrow as appropriate. I have nothing I want to add to Tom's eloquence and expertise other than that. That is all. I thank you very much.

Again I thank our staff, congressional staff, too, for taking their time. As those of you who have tried to contact them during the week may know, these are folks who cannot always get back to you immediately because they have demanding masters and work long hours. This is a remarkable occasion.

Mr. SHERIDAN. Thank you, John.

Before we finish, I wanted to ask Wally Berger a question.

You mentioned that there was some surprise there are no technological show-stoppers. I am wondering whether in your judgment the identification of some show-stoppers we can anticipate is an important part of our charge. In other words, is it necessary to identify show-stoppers in order to enable the infrastructure to help advance automation?

Mr. BERGER. I think it is necessary to define limitations that exist now either in terms of knowledge or in terms of technology and to think very hard on the issue of whether we should press ahead in an accelerated rate on solving those problems and what benefits would be derived from solving them in the context of a very large applied program that is probably going to represent the major single technological focus in many of these areas over the next 20 years.

So, yes, I think it is very important to identify the show-stoppers. One of the major things that bothers us on the committees is when you have a program that is designed to be doable in the next decade—and this is what the President said in his State of the Union Address—that the tendency is from a manager's standpoint—and this is a good manager's decision—that you go around the technological show-stoppers and you find another way of doing that. When you have the option of having six or seven or eight people in that low Earth station, there are many ways you can use them to avoid addressing these technologically difficult issues. We are very concerned about that.

So I think, yes, the answer is we do want to identify those show-stoppers.

Mr. SHERIDAN. Part of the problem, I think, all of us know we are talking about technologies that willy-nilly will evolve, maybe not quite as fast or as dramatically as demonstrations in space could bring about, but there are many, many evolutions that want to happen.

I am just a bit puzzled about the degree to which one has to have a dramatic demonstration or whether it is enough to say we want to accomplish a certain number of scientific experiments. When we talk about show-stoppers, I guess we mean dramatic events that have media value as compared to the grist of the usual scientific experimentation.

Mr. BERGER. No, I would define a show-stopper, for instance, as developing a very good three-dimensional vision system. To me that is a show-stopper. It might not be the thing that is really going to grab the housewife as something that has great application to cleaning up the table, although it does, but that is a show-stopper. It is a technological show-stopper, not necessarily something that will be on "60 Minutes."

My sense is—and this is a personal view, just as Dan's was a personal view—that we have a tremendous opportunity here to capitalize on a very large investment. It is true, as you are saying, Tom, that eventually, 100 years from now, we will probably have the technology because we are not going to be able to have 200 people on the space station, we will have to find ways to do these things more efficiently. But in the realm of international economics and competition, time is of the essence. Every time we read an article in the Wall Street Journal about super computers of our friends in Japan, whether that is real or imagined, we recognize that events technologically move very quickly.

So I think our approach is to use this opportunity to move those things along on a faster track.

Mr. RUOFF. I think what you are saying is true, but I mentioned earlier military environments as being actually more difficult in the sense of requiring more higher level reasoning. I think there are many technical areas now on the verge of wanting to apply all types of advanced—what you might call computing capabilities for want of a better word. It is becoming difficult for people in research organizations who have historically dealt with esoteric A/I areas to protect their turf. There is a great demand for applications, so A/I is becoming a salable skill with real market potential. I think research is being forced to look for more far out things to deal with.

I believe that even if the space station chooses not to address any intelligent automation, that the military imperative is going to force it to be developed anyway because responding in a quarter of a second versus a half second when a missile is coming toward you means the difference between death and survival. I don't believe that any one of the Government programs will be able to monopolize the development of this technology because it is becoming so important.

Mr. SHERIDAN. One of the nice things about the space station is that it is public, unlike the military, where you can't always demonstrate openly. The best stuff is kept a bit under wraps, isn't it?

Mr. ISLER. But the software in this area haven't yet been captured by that part of the Defense Department. They are still part of the technology-based community, and so if you look at the super computer program, strategic computer program we call it now, it has a lot of the technological show-stoppers of the type you were talking about.

I really endorse that. Of course, if you look at the list of potential uses for the infrastructure—is it infrastructure? Yes. Then each one of those areas would have its own peculiar set of potential show-stoppers, its own technology voids that would have to be addressed before we could do them.

I don't know whether $20 billion or $8 billion or whatever would permit us to do that whole shopping list. But I think that is one of the things we have to do also, or someone has to do, is decide in these milestones or show-stoppers to put some kind of priority to that list of possible jobs that this thing would do.

Mr. SHERIDAN. Roger?

Mr. SCHAPELL. Unless the three technologies we have been talking about most times here are the paramount thing, I think that there are other things that we are going to get into or should get into that are going to have quite an impact. When I look back at the Vikings and Skylabs and where we spent our money and time, it was, No. 1, in the way we designed things, the tools we didn't have then and have now, and we are not really addressing those at all here, I don't think. Perhaps we will tomorrow. But when you break down the cost of a given program, like Skylab or Viking, and look where the money went, you have to do the same thing here, I feel. You are going to find that the more glamorous technologies are very nice, but you are going to find that the savings are going to be extreme in the less interesting things.

Mr. RUOFF. Automating terrestrial support, for example.

Mr. SCHAPELL. Yes. I can think of a series of things. I think it is something we ought to talk about tomorrow.

Ms BAJCSY. You are saying that is where the savings will be less?

Mr. SCHAPELL. Greater. It doesn't matter whether it is automated.

Ms BAJCSY. The support.

Mr. SCHAPELL. Yes.

Mr. TAYLOR. A lot of the spinoffs will be there, too. If you automate terrestrial support for space stations, you have automated terrestrial support for other things, too.

Ms BAJCSY. Absolutely.

Mr. TAYLOR. I was thinking of one analogy to clean rooms in electronic manufacturing. You really want to get people out of clean rooms because people are dirty. They give off particles and oil and so forth.

The higher the degree of automation you can achieve, often the better your product quality and the lower your costs and all of these other things. So here is a clear area, I think, where basic technology for automating manufacturing operations in a space station would have great application on Earth.

The flip side of that is that I don't think we are going to have people completely out of clean rooms by the 1990's. However, even learning how to design a manufacturing system for ease of access for maintainability is an example of what could be learned from studying how you would automate certain aspects of space manufacturing. It has a tremendous payoff.

Again, I think it is an example of what Roger was talking about.

Mr. ERIKSON. I want to ask a question concerning the notion of show-stoppers. Are you using the concept as an economic and/or technical constraint that is binding now and that has to be resolved before any new investment can be made, or, rather, as a constraint which is binding now but does not preclude engineering work and studies to ease or remove the constraint? Is my question clear?

Mr. SHERIDAN. I would hope it would be, if I understand you, I would hope it would be the latter. All of us who go with our hands out to the Government to get research support have to write a proposal, but we all know you don't always end up doing what you propose. You get into the work and moonlight something else which might turn out to be much more valuable than what you proposed.

Mr. ERIKSON. I first thought of a show-stopper as something that is really fantastic, that really inspires one to try to reach higher levels of achievement.

On the other hand, I thought that maybe you regard a show-stopper as something that really turns out the lights and causes everybody to go home because you don't have the wherewithal to achieve a particular kind of mission? It really shuts down things rather than stimulates innovation.

In what sense are you using show-stopper? Is it in the sense that we'd better go back to the drawing board because we don't have the problem solved yet, or is it that we don't yet know how to get there but are stimulated or challenged to undertake engineering and design experiments, anyway, to overcome those problems and constraints?

I wasn't quite sure if it was a show-stopper in the sense of, let's work harder, let's stretch our imaginations and press on, or, rather, in the sense that we must slow down and work on these problems before we move ahead?

Mr. BERGER. No, I think the former definition is obviously the more constructive one, of looking at areas where you have an identified deficiency and you realize it is not a 200-year problem, but it is a matter we have been picking away at this problem at $100,000 a year, we ought to spend more resources on it. I think there is a corollary, though, in every one of those areas where you have a mission identified, where perhaps there is a show-stopper, that is going to be a very difficult one. You are going to have to spend a lot of time on it. You have a couple of options.

You can scrap the mission. That is pretty severe. You can reconfigure the mission so that it fits something that you know how to do, or you can do the mission with some other assistance, like manned assistance.

I think all of those options are legitimate. My focus, and I think the committee's focus, obviously was trying to identify those areas where we need some additional emphasis. And they are short term. Maybe we need a class 7 computer.

Mr. NITZAN. Coming back to the issue of autonomous mission station, it seems to me that the technical and economic issues here vary with time. Today there are certain functions that are much easier to do automatically. James Van Allen was talking about 25 years of his experience with essentially autonomous machines. Some functions must be done fully manually today. As time goes on, we will see that the number of manual functions decrease and autonomous ones increase. I can see a family of stations, some fully autonomous and others partially autonomous, cooperating with each other.

Mr. SHERIDAN. I think that is right. It seems to me if there is nothing else we can do, we ought to disabuse certain people in high places it is either man or machine. Some mix obviously makes more sense than either by itself.

Mr. NITZAN. And it will change in time.

Mr. SHERIDAN. Of course it will.

Mr. ARBIB. This is really a question about the appropriations process. As a member of the AI community, I am certainly grateful for how much we have benefited from DARPA funding and I look forward to the spinoff of the space station project. But, where is the forum from which one can stand back and look at appropriations to individual agencies—NASA NSF, and so on—and try to see what really is the fundamental research that would have the maximal impact on our national defense, on our space program, on our manufacturing capabilities and so on?

There seems to me, from what I have seen, a sort of divide and conquer. A most dramatic example has been that, at the time at which we are trying to react to the Japanese approach to overall planning, we dismember the Bell system.

So my question is: Do you have other people coming in for that deeper analysis of what really are the spinoffs we want and how can we best fund them, rather asking how we can configure DARPA-NASA so there are some of these spinoffs?

Ms. NAISMITH. Yes.

Mr. BERGER. that is an easy question. There is no answer to the question because the Congress doesn't do that. In this country there is no central science planning agency that conducts that function. We have an Office of Science and Technology Policy which worries about more microscopic issues than we are discussing today.

I think it is interesting to note along those lines that next month we will be holding a hearing on super computers which involves DARPA and DOE and NSF and the Office of Science and Technology Policy under the auspices of our subcommittees and two other subcommittees, Defense and Energy. As far as I know, that is the first hearing that will have been held where all of the major players are present.

I don't have an answer to that. We don't do that as a government. We never have. There are obviously philosophical pluses and minuses to doing that. I am not sure you would like to entrust that to the Congress.

Mr. BRANSCOME. I am sure you wouldn't. [Laughter.]

Mr. SHERIDAN. Let's promise ourselves we will quit by 9:30.

Mr. RUOFF. I just want to make a comment. The most stable kind of technology is mechanical. People have been building weapons and buildings for a lot longer than they have been building electronics. If we build a space station with the idea that people are going to occupy it, its mechanical and structural aspects will probably change the least over its lifetime. Electronics, on the other hand, is evolving so rapidly that if we freeze the technology 5 years before a space mission, it is really obsolete by the time we fly the mission. So it would be fair to say we could build a space station structure, the stuff that is stable for a long period of time, and initially radio link information from the space station to the ground, kind of extending the bus down to the ground where it could be processed and control decisions made using humans and existing computing capabilities. As computational capabilities improve and circuits are miniaturized, we put more of the computing capability back on the station. If the station architecture and structure were designed in such a way, it would be easy to retrofit distributed sensors through the structure and easy to add computing capability to enhance on-board autonomy. We would basically be pulling the bus back in from the ground and putting it back into the station.

I think that would be a fairly useful evolutionary approach to take and would give us a lot of flexibility from the standpoint of being able to allocate functions in both the near and far terms.

That was only a minute and a half.

Mr. SCHAPELL. You are suggesting designs for growth then, we would never have been able to do that.

Mr. RUOFF. But in the case of electronics——

Mr. SCHAPELL. I understand.

Mr. RUOFF [continuing]. If you allocate 15 cubic feet for a memory, and can, subsequently, put it on a chip, you can obviously incorporate the improvement in the station. We are not trying to change the capital structure. We are just simply trying to change the black boxes that go into it.

Mr. ROGERS. Let me ask one question of either Luther or Dan or both. When you get down from the conceptual and the philosophical, down to the next level, have you gotten to the point—let me just say Dan, because I have known him longer—Dan, have you gotten to the point yet where you have on the back of an envelope a few particular functions that you would really like to see accomplished in space by some very smart machinery instead of a human being? Have you got one or two of those that you could just give us an example of?

The Congress is now giving consideration to the President's request that NASA be allowed to proceed with the acquisition of long-term in-space infrastructure—a so-called civilian space station.

NASA has said that a program to do so would require some 2 years of detailed study at the outset; that is, prior to any final decisions regarding the specific functional capabilities to be expected of such infrastructure and the engineering and procurement approaches preferred in realizing them.

NASA sees the opportunity, indeed in certain cases the necessity, of incorporating automation in various elements of any such infrastructure.

Subsequent to the conclusion of the March 19-20, 1984, OTA workshop that addressed automation in space, OTA staff working on its civilian space stations assessment requested NASA to provide them with a brief descriptive list of some of those capabilities that, in NASA's present opinion, could profit from being automated.

NASA provided OTA with the following list. The reader should appreciate that congressional actions could well modify NASA's present program aspirations, and any NASA studies probably would refine their engineering judgements. Consequently, the material that this list contains should be understood to reflect an informed, but early, professional view of an important and complex area.

[The information follows:]

PLANNED SPACE STATION ACTIVITIES THAT WILL REQUIRE AN ADVANCEMENT IN THE TECHNOLOGY IN ROBOTICS AND AUTOMATION AND/OR EXPERT SYSTEMS

The assembly and/or the construction of the space station on orbit.—The space station will be constructed in space by assembling modules transported in the cargo bay of the Shuttle. These large objects will require handling by a remote manipulator with the proper sophistication to provide for precise positioning of the modules for assembly and controlling the stability of the emerging space station as it grows (modules are approximately 14 feet in diameter and 25 to 35 feet in length).

Activation and verification of the space station.—Assembling the space station will require a verification of the operating systems; that is, that the life support, power, heating and cooling systems are working properly and are able to support the next step in the operation. This will require that these vital systems have the capability of remote turn on and automatic evaluation of the health and well being of each. An element of this automatic activation will be the ability of the system to conduct self-diagnosis in the event that an abnormal condition occurs. Advancement in the technology of automation and expert systems will be required to perform this important phase.

Space station operations monitoring and control.—Beyond the activation and verification phase is the day-to-day space station operations phase. The space station is dedicated to the performance of science, applications, commercial materials processing in space, satellite servicing, etc. In view of the small crew size (NASA is currently thinking of two to three active crew members per shift) space station operations tasks are strong candidates for automation in order to relieve the crew for the nonroutine functions clearly requiring human presence. They will also require significant advancement in the area of automated or expert systems.

Fault detection and isolation.—If a space station is to be largely autonomous from ground control (as are nuclear submarines) it must have the built-in capability, first, to detect any abnormalities in the operations of any of its systems, and then to determine which item(s) within these system(s) has (have) failed and, finally, to assure that the station remains in a safe configuration. This fault detection and isolation will again require advances in expert systems technologies in the area of sensors and sophisticated computer software. However, the character and complexity of fault detection to which these systems will be able to respond usefully will be directly related to the ability of the systems designer to predict, objectively, the symptoms of the faults.

SPACE STATION TASKS WHICH ARE AS YET UNPLANNED, OR WHICH ARE VARIED IN COMPLEXITY AND/OR REPEATABILITY, THAT WILL REQUIRE RDT&E PROGRAMS ADDRESSED TO LEARNING HOW TO DIVERSIFY AND ENHANCE THE SPACE STATION'S ROBOTICS AND AUTOMATED CAPABILITIES

Full-fault detection and isolation.—A continuing effort to increase the capability to deal with all possible faults and/or failures within all of the operating systems, and to restore the station to a full operational stature.

Maintenance and repair.—The constituents of each system will eventually require replacement. The ability to replace failed items and/or to repair failures will require a robotics and/or telepresence capability that can handle a diversity of complex tasks either automatically or under remote human control.

Servicing and launch of space-based vehicles.—The space station servicing concept expects to utilize a remotely controlled space vehicle that will initially ferry satellites back and forth to the space station. In addition, reusable high-energy vehicles that can carry satellites and other assets to higher orbits, including the geostationary orbit, and eventually provide for planetary probes and solar system exploration generally, will be space based at the space station. These vehicles will require remote refueling, servicing/checkout for launch, and ultimately retrieval, test, and repair. Given the small crew size, the accomplishment of tasks analogous to those carried on at the surface at Kennedy Space Center will require a high degree of automation and robotics in orbit on the space station, as well as within these vehicles themselves.

Satellite servicing: In-situ—If satellites are to be services in-situ, any reuseable orbital transfer vehicle (ROTV) must incorporate advanced telepresence as well as robotics capabilities to accomplish, remotely, a diversity of complex tasks.

At the station—If satellites are to be brought to the space station and serviced there, an advanced robotics capability will still be required to accomplish much the same range of complex tasks.

Payload operations.—This is the area where tasks are most difficult to define and least likely to be repeated. The wide variety of disciplines expected to be in use, and the variety of instruments, experiments, and apparatus to be accommodated in such use, undoubtedly will require the highest degree of diversity and sophistication in expert systems, robotics, and/or telepresence capabilities. Learning how to accomplish these kinds of tasks will be the greatest catalyst for space station technology development.

Mr. HERMAN. One or two. We are studying this in conjunction with some other agencies. There are some assets we would like to service that are not in shuttle compatible orbits. Someone mentioned the concept of telepresence, developing that. Some of the unmanned systems we are putting up are so expensive we would really like to service them; not from the standpoint of fixing it when it is broke, but servicing them from the standpoint of a value-added function, such as changing focal plane instruments; putting in new sensors when they are developed; improving the capability of those systems, et cetera. If those satellites are in nonshuttle compatible orbits, the one thing you really need is to first of all design those systems so that they are amenable to being serviced. They have to be designed in such a manner that elements you plan to add for upgrading can be done. Then you have to develop the kind of telepresence, the kind of tactile sensors, visual sensors, to be able to have a man in the loop service these assets without his physical presence.

Mr. POWELL. I guess you could call them more mundane things. You could make the analogy to forklift designs of a while ago. If you analyze the process of maneuvering things in space with an orbital maneuvering vehicle, and the design for that, and you go back to the cape to look at what is required, manpowerwise, to service and launch those kinds of things, the manpower is quite large. Now you know you can't operate in that mode on orbit because you won't have that many crew members. This dictates to us that we have to open our thinking to more automation, more robotics, more automation within the shuttles themselves, not just in the space station. So the self-sufficiency of the vehicles and the things to be serviced is going to be higher, as well as the capabilities of the space station to do those things remotely.

So if I were to try to characterize it, I think the show-stopper is to take a look at all those things we normally do manually today, like insuring the safety and excellence of the job and see if it's practical to do, the same quality of work by means of an automated system. We, at least, should try that.

Mr. ROGERS. That is a good example.

WORKSHOP RECESS

Mr. SHERIDAN. Maybe with that we will retire. It is 9:30. Thank you all. We will start promptly at 9 in the morning.

[Whereupon, at 9:30 p.m. Sunday, March 18, the workshop was recessed to reconvene at 9 a.m. Monday, March 19.]

WORKSHOP ON AUTOMATED SPACE STATION

MONDAY, MARCH 19, 1984

U.S. SENATE,
SUBCOMMITTEE ON HUD-INDEPENDENT AGENCIES,
COMMITTEE ON APPROPRIATIONS,
Washington, D.C.

The workshop convened at 9:10 a.m., Thomas Sheridan (Massachusetts Institute of Technology) presiding.

WORKSHOP AGENDA

Mr. SHERIDAN. Well, we have a gargantuan task to do in 1 day. There weren't any vehement objections to the agenda the way we had it set for today. In our judgment, this still seems to be the best way to get on with it. Keep in mind what we want by the end of the day is something specific and not a lot of mush. And you can make my job a lot easier by keeping that in mind. Certainly at the beginning we got to do a bit of philosophizing and so on, get our bearings to understand each other semantically. I think there is still a little semantic confusion on this show-stopping business—I am sorry I even brought it up yesterday.

We really ought to have at the end of the day some assertions, as specific as we can make them, about the efficacy in the short run or the long run of various kinds of automation, at what level, in what mix with humans, if that is what it comes to. We ought to speak to this matrix to some extent. I think we all have a copy of it.

In any case, it is clear that it is difficult to put marks or numbers in the matrix and, we are not suggesting we must achieve that. It is also clear that those functions that are listed are a very reasonable breakdown of the kinds of things one might want to do or that we, in fact, need to do in space. But it is just as clear, when you come down to the technological pieces that have to do with sensing, manipulating, orienting, and so on, there are pieces of those technological components everywhere

So, I would hope that, particularly when you get to your groups, you would speak to this agenda and, perhaps, take a cell or two, some part of it, and go into some depth explaining what can be done by when and how and what some of the problems are. Wally and the other congressional staff people really need as much specific as we can muster—I won't say ammunition because that would prejudge, that they already knew their position.

Now, some of you have asked me questions that I can't answer. They are questions about what are NASA's real plans, what is the real agenda for spending money or allocating resources or time schedule. I am not sure all of these questions have answers at this time. But, it seemed appropriate to get at least some of those questions on the table and let the NASA folks present have a crack at them to clarify where we ares. I have a few myself.

So, before we get into that discussion, are there any final concerns about the agenda? At the moment we will talk in plenary, at least until late morning probably, depending on how things go. We will break up at some point in groups. If some of you completely object to where we stuck you, please tell us. We will try to do some readjusting. Then we will stay in those groups through lunch and into the afternoon and expect you to produce some stuff in writing. For one thing, the time is too short to get testimony in time to be useful for these folks. Second, once you leave here I think you all know you will be too busy to worry about writing stuff and getting it back here. So we will expect some words from you while you are here. If you do that in groups we will expect some position, statement, or committee report shortly after lunch, which we will then have further discussion about and use to formulate some consensus positions before we leave.

Mr. TAYLOR. I am not sure if this is exactly an agenda concern, but to pick up on point yesterday about the relative permanence of the mechanical structure of the space station as compared to its intelligence, it does seem, in assessing what we think about possibilities of automation, we ought to consider what the upfront interface requirements such as those for mechanical structure access might be and what the implications of automation are. If we think it is feasible to have an autonomous repair robot that really can function without human physical presence, that makes a big difference in the way that you design that piece of the spacecraft. It may make it better, it may make it worse, but when you start something that you are planning to have evolve functionally, it seems to be very important to think about the interfaces that are going to change during the evolution.

TIME DELAYS

Mr. SHERIDAN. That is right. Not only are there mechanical interfaces, there are other kinds of interfaces, communications.

One of the questions I was going to ask the NASA people is, what kinds of time delays are they planning for, not only speed-of-light time delays but processing, date processing time delays which is the big piece of it. What kind of bandwidths? If you are talking about high data rates, it is not clear we are going to have them. So those kinds of questions come up.

Mr. ALBUS. Tom, along that line, there has been a number of studies in manufacturing based on how you redesign parts, if they are going to be built by robots or systems designed for automation. One of the curious things that have come out of that is that, if you design parts well for automation, they are easier for people to put together. And, in fact, it may be a good design philosophically for the space station to try to design electronic instrument panels and racks and packages so that they could be replaced by robots or manipulators of some type. And if that were the case, it would be probably much easier for the astronaut to service as well.

So the way the space station is designed should take into consideration what manipulations have to be done to get something out. If you have to pull out wires and snake through with your hands behind a rack to do something, that task is virtually impossible for a robot to do, and it is also very difficult for a man to do.

It seems to me, particularly in the mechanical layout of where racks are and the access doors to equipment and so forth, and the way connections are designed and boards are designed for pulling out and putting back, should be carefully thought out in terms of whether it would be possible for a robot manipulator system to do that same task.

Mr. SHERIDAN. I think that is a good point.

Roger, you had some experience in this.

ROBOTIC SATELLITE SERVICING SYSTEM

Mr. SCHAPELL. In the past we have done this sort of study. In fact, we had in excess of $2 million out of Marshal where we looked at this very problem. In other words, there was a program called IOSS, which was robotic satellite servicing system. The implications of that system was that all future satellites be designed to accommodate this robotic system. It can be a fixed program system. The problem with the system was that for some of the same reasons that we don't have robotics in manufacturing and costly aerospace products, we couldn't use it in space because we couldn't save the system. If the thing did go out of control it might destroy the component which becomes one of the primary considerations here and the reason why you can't directly transfer industry robotics without the safety consideration in mind.

So, the IOSS was designed to accommodate spacecraft that were designed to interface with it. Then later on in a more recent future we built other systems like the prototype manipulator that would be teleoperative. Now we don't have to have the other things designed to accommodate that robotic system.

Here to assume that you are going to have interfaces that are well defined and somewhat universal connectors I think you have to do that. But you are still going to have a flexible system robot in space because you might have a fuel cell exploration. It is not always going to be the perfect structure environment that we all associate with space.

Mr. ALBUS. I am not suggesting you try to design everything so it can be done by a complete—something that is run off with program sequence. But, for example, it is a lot more complicated to have two-handed manipulation if you got something to push something in and hold it with one hand and screw something with another. That really places an increased demand role on your robot.

Mr. SCHAPELL. You wind up with the system. Removing and replacing hardware, that would be a fixed program.

MAN-MACHINE RELATIONSHIP

Mr. SHERIDAN. Before we go on, Mike Brady from MIT Artificial Intelligence Laboratory just came in.

Mr. NITZAN. I have two questions of NASA. First, in today's Space Shuttle, how many functions do astronauts perform by following a machine that tells them when to push buttons and then something happens automatically by machine?

Mr. HERMAN. I don't know, but that syndrome, in effect, is creating an image that man is real useful when, in reality, he can be completely replaced. I don't think that is part and parcel of the Shuttle operation.

Mr. NITZAN. I think that knowing the percent of such push-button functions is very important. If you can put a number to it, please tell us where we are in terms of manual versus automated operations.

Mr. HERMAN. I have a paper that I will get by this afternoon that, in effect, describes precisely what man's role is in Shuttle operations. I believe I have a draft with me.

Mr. NITZAN. The next question I have—and we talked about it in the break—is related to long-range planning, although I realize that the budget is established yearly by Congress. What is NASA's master plan for the next 5 to 10 years regarding the resources that would go into R&D for autonomous operation compared with manual operation?

NASA PHILOSOPHY

Mr. HERMAN. Rather than couch it that way, let me couch it in terms of what are NASA's desires. Among NASA's science, applications, and technology endeavors, which are unmanned for the most part, the largest single budget increase between 1984 and 1985 in all of NASA was in the Office of Space Science and Applications. It was considerable. And all of those were endeavors that are unmanned. They had to do with continuing programs like the Gamma Ray Observatory, they had to do with sustaining Galileo. There were new start proposals in the 1985 budget, one is the Mars Orbiter and the second is the Upper Atmosphere Research Satellite.

As far as the manned endeavors are concerned, the space station program, from a philosophic standpoint, was discussed very briefly in the paper that Tom Rogers passed around. What NASA is proposing is 2 years of intensive definition before we commence hardware development. I've heard some people suggest that we design specific elements in order to make them amenable to what we call technology transparency. We have not even started that process yet. In the next 2 years that is precisely what we are planning to do with the resources that we have requested to establish a design approach for the space station. We have to have a well thought out approach before we commit funding for hardware development.

Aside from space station, the money in the manner space flight arena that has been sought has to do with a whole host of improvements to the Shuttle—one is strengthening the landing gear so that the Shuttle can take up a much greater payload weight than it can right now. I believe that the liftoff weight is 65,000 but the landing weight is 34,000. There are improvements like that that have been proposed to make the Shuttle more efficient. But aside from the space station, there are no major manned expanded flight endeavors at all envisioned for the next 10 years.

Now, the space station can be best described, using Tom's words, as an infrastructure facility. The concept that we had in mind—and this has been discussed by Mr. Beggs and a lot of NASA people during testimony—is a capability that will be added to by increments. In effect, one way to think about it is that equipment can be designed in such a way that you can change the computers, change the instruments, and as technology progresses you can take advantage of that capability.

Now, this approval is not radically new of this concept. The B–52 airplane is one example. It has been in operation for, I think, almost 20 years. The fuselage looks the same, the engines are roughly the same, but nothing else about that airplane is the same. That is the sort of thing that we have in mind as an approach to the development of the space station.

In addition to the science and applications programs and to the manned space flight budget, the other two major segments of NASA's research and development budget are the aeronautics and space technology program which remains roughly and our tracking and data acquisition, which provides things like the TDRSS.

The one other thing that I would like to state, and this is also on the record, Mr. Beggs proposed that we do develop the space station within the confines of a projected growth in the NASA budget that will increase by 1 percent in real year dollars over a 5-year period starting in the fiscal year 1985. And the rational for this is the understanding that it would be wrong to develop a space station without having the resources in the user communities so that the space station can be used effectively.

MAN IN SPACE

Mr. BERGER. I would like to expand on two comments. One has to do with manned activities over the next 15 or 20 years. I might just note in terms of the Space Shuttle itself, the level of activity on the Shuttle, the estimates that we will have 24 flights a year by the year 1989. What that plan comes to, in terms of manned activities, is somewhere close to the equivalent 4½ man-years in space per year just for the Shuttle crew themselves. So that is something when we look at manned activities I think you should be aware that there is a significant manned presence expected in space in addition to anything that might be available in the station.

If you look at that within the context of the history, 23-year history of manned space flight, U.S. manned space flight, that far exceeds everything we have done in those 20 years, those 4½ man-years per year. So that is one connection.

The other thing that I might mention is 1 percent real growth, I think that is something that has been worked out with NASA, with the administration, something that NASA obviously is very interested in and those of us in the scientific community that have other things to do in addition to the station are very interested in.

I might just say that as most of you recognize, the budget is made up in yearly increments and those long-term commitments to 1 percent real growth often do not pan out what you expect them to be. This same type of commitment, of course, was made back in early 1970 when the Shuttle program was initiated, there was agreement between OMB and NASA that NASA would be made whole for the Shuttle program and it would not impact the science activities. But from my personal standpoint, I wish that we could tie these things down a little better because I think that is how we ought to manage programs, we ought to safeguard some things that do tend to get the short end when we get into a big development program.

This is from a political reality standpoint, that 1 percent, that is going to be subject to review every year and a determination will be made every year whether that is still a viable policy or not.

DATA DELAY

Mr. SHERIDAN. Before we leave the interface question, which we just talked about a moment ago, is there an answer to my question about time delay in bandwidth?

Mr. HERMAN. As far as bandwidth is concerned, all of the functions we have looked at up to the year 2000 are based on the assumption that we would have 300 megahertz bandwidth at TDRSS. I think that the real question being asked is, what is the time delay of the function you have to perform in order to determine whether man can be there in situ or whether man can be there remotely. I think that is a very crucial part of a separate robotic/automation study that we will start very shortly.

Mr. SHERIDAN. The chicken and egg problem. Clearly if you shorten up that time delay you can carry out more functions from Earth.

Mr. HERMAN. Some activities that have been proposed by our life sciences committee require a very short time constant.

Mr. SHERIDAN. Are you implying you might have high data channels that could be a long time delay and a few low data channels that could be very quick.

Ms. BAJCSY. I need some clarification. I am confused. I thought that our charge was to think about autonomous scenario. Now the discussions today seem like what we ought to think about is maybe an evolution from a manned scenario through some hybrid scenario to completely autonomous. The reason I would like a clarification is that if we go with the latter scenario, which is evolution, then it seems to me that the whole design, the whole technical approach will be different; namely, we will accommodate for the hybrid manipulators, any hybrid environment where man and machine will have to interact.

I thought that if we go by autonomous scenario, then one can take a completely new and fresh approach about the problem and look at it how one would go about designing a completely automated scenario. I would like to understand what is the charge of this committee.

AUTOMATION INTENT

Mr. ROGERS. My understanding of Wally's intent was that we focus on a completely automated set of infrastructure. We all know that getting there from here is probably difficult, but thinking in this fashion was the purpose of our organizing this group. Wasn't that your intention?

Mr. BERGER. I think it was. I think when you talk about the sequence of this continium in automation, I think it is important to start with the concept that you are going to push the frontiers of automation until you run into a roadblock, until you find there is a mission that is so important that it has to be done and it can't be done in an automated way in the time frame that we are talking about. So I would take that approach.

In reference to an earlier comment, I would like to mention something that is relevant here, too. And this is some testimony that Lew Branscomb, who is the vice president of R&D at IBM gave before the House Appropriations Committee last week when asked several questions about the design of robotic station and, in particular, Mr. Baldwin asked him about cost issue and I think his question has relevance beyond the cost but he said:

> I said probably it would be cheaper to design an automated station. I said probably because if you reoptimize the entire space system so that it did not require the demands the Space Shuttle places on it, then I think one can replace the cheaper system that it was unmanned. But if you start with the system built for man and simply remove the people because the safety threats are so severe and the like, it is not clear that you save as much as you would with a redesigned system.

I think that is relevant to the discussion.

Mr. TAYLOR. But if you design—if you sat down today and designed the completely automated system, you wouldn't get there in time, you couldn't get there quicker than a century.

NASA INFRASTRUCTURE INDISPENSABLE

Mr. RAIBERT. This is related to the political problem that exactly parallels the one that Wally Berger just mentioned, and that is this machine is going to be built with some NASA infrastructure; that is, the people that are already in NASA and the facilities that NASA already has and to the extent that that organization is geared toward putting men in space we are going to have to live with that and to the extent that NASA is committed to having men in space can't be dissuaded from it, we have to live with that, and to the extent they feel that certain things can only be done with men we are going to have to live with that too, I think. We could wipe the slate clean and build a new organization committed to building things in space and maybe we have something in another hundred years—maybe it wouldn't take that long, but I think that the idea that someone is going to force NASA to do it the way that they don't believe in is wishful thinking. So, I think there is going to have to be a compromise somewhere along the way between what those who believe in automation and those—the economic arguments or whatever arguments are of automation and the fact of life that there are those for some reason for a set of reasons believe that men have to be up there.

Mr. SHERIDAN. Mike Brady.

Mr. BRADY. First of all, let me apologize for not taking part in last night's festivities.

Marc Raibert just argued the political feasibility of a completely autonomous station and Russ Taylor the technology capability. I wanted to make a comment along that same general line. I read the material by Rogers and Chandler and Johnson. One thing that comes through clearly, for whatever reason, is that their thinking is to have a manned machine system to deal with surprising events, to deal with life-threatening events, or other situations that require complete trust by man of machine.

PREDICTABILITY OF ENVIRONMENT

The question that we have been charged with did not come through at all in those documents and I find myself in a difficult situation, since I don't have a good sense how structured or predictable the environment will be that we are going to build a machine to work in. If it turns out that the environment is relatively predictable or the demand of activity of any machine is relatively circumscribed—though considerably less in terms of current practice—then I do believe we can take hold of existing technologies from robotics and artificial intelligence and we can begin to do something that is significantly better than current industrial practice and do something that is cheap and extremely useful.

However, I think it is important to record that the idea of dealing with a completely unconstrained environment or completely open problems—notwithstanding warm stories about robots and wonderous expert systems—than such a system is simply not around for the next several decades.

So I really don't have a good sense of the extent of predictability of the merits.

DESIGN ENVIRONMENT

Mr. ROGERS. I think there is one basic observation. I think it is going to be one of the most stable, most benign environments known to man. You are going to find yourself up there, whoever you are, man or machine, inside a great pressure chamber in which the astmosphere and the temperature and the pressure thereof is very, very well controlled, very safe.

Mr. BRADY. I am talking about the placement of objects relative to machine, where they are best put together in assembly. Orientation of objects has been pretty well known to most industrial applications. The laboratories are somewhat more tolerant of uncertainties. Perhaps uncertainty would be a better word than environment. At the moment, I don't have a good sense from all the stuff I read of what the degree of uncertainty would be.

Mr. ALBUS. I think the uncertainty is pretty low because you are in a carefully designed and engineered pressure chamber. All the cabinets are known, and the contents of the cabinets are known down to where each item is located in each cabinet. There should be low uncertainty. There will be no rubber giraffes floating around.

Mr. SCHAPELL. That is not true; there are many things floating around.

Mr. ALBUS. My guess is the space station environment will be much better defined than your average machine shop here on Earth.

Mr. ROGERS. You can have experimental platforms devoted to things that might give difficulties if there were people thereon.

Mr. SHERIDAN. David.

Mr. NITZAN. I have read in newspapers about all the good things we want to do in the space station. But specifically what and how to do them is what I don't know. In today's factory or laboratory, people perform primarily three tasks: The first one is material handling—load, unload, et cetera; the second one is inspection, whether it is implicit or explicit; the third one is assembly, which is quite complex, and includes the first two tasks. Sensing and cognition is entailed in all three tasks. And these are the kinds of issues that R&D in robotics is attacking.

I agree with you, Tom, that we can constrain the conditions to improve the performance of a given task. In that way the task process would be less flexible but more structured, more reliable, and less costly.

Mr. ALBUS. Isn't that also true that the astronauts have a mission which describes what the task is on 1-minute intervals?

Mr. SCHAPELL. Except you are also going to have to sort out the Skylab; there is no book to tell you that.

Mr. ALBUS. But even the astronauts don't fail to consult with the ground and get additional instructions and ideas as to what to try next.

DEFINITION OF SPECIFIC FUNCTIONS

Mr. SCHAPELL. You are talking about two different functions relating to it and then you have what the space situation is up there with respect to other satellites, et cetera. We know how we are going to operate with the space telescope, we know how we are going to prepare. With respect to the space station itself, you can define that if you look at the other programs. You can define specific functions, if you will.

Mr. NITZAN. You can make it more constrained.

Mr. SHERIDAN. David Akin.

Mr. AKIN. This is a very interesting conversation. I hear a lot of people proclaiming the anthropecentrism of NASA and I have worked for a long time with the crew systems people and engineering people of both Marshall and Johnson Space Centers, and I think everybody there is perfectly willing to admit that the best way to work is often a mixture of people and machines. Yet, I come in here and I hear a lot of voices saying obviously we want to go to totally automated for space station, get people out of it altogether; I have not heard any reasons why that is worthwhile.

Mr. ROGERS. Let me give you a reason. Supposing I approached the U.S. Navy and say we have thousands of people on our aircraft carriers, would you think very, very hard about how we can get some of them out? They will be very responsive, hard-working, thoughtful, and come back saying stripping down everything, we can reduce it by about 5.6 percent. So the next thing I would do is say, now let's try to design the next carrier with no people on it and only grudgingly allow ourselves to think of allowing the first person aboard. It is an attitude. I don't think anybody here would say that over the predictable future we would have large elements of this infrastructure, very large elements, wholly automated and completely reliable, but for the purpose of this discussion let's take that initial target of trying to imagine how to do it.

Mr. AKIN. I think you are prejudging the answer.

Mr. ROGERS. But we do this in university labs all the time.

For instance, I do think you could have another meeting of this kind in which you said there would be no automation whatsoever, we will throw it all out and make the infrastructure the quintessential man and women space habitat of all time. That would be a very reasonable thing, you could decide, but then couldn't we give them one screwdriver and add some chalk and the blackboard.

I think of this workshop in the sense of an intellectual exercise; it is not a bad thing to take an extreme case and then see, after you have examined the extreme case, what you have to give up.

Mr. AKIN. I think that is fine, but what if a month from now I read congressional testimony that says, "OTA panel of experts say station should be totally automated"? That was not an intellectual exercise; that was an engineering decision.

Mr. ROGERS. I doubt that will happen. If it does, you can write me a very nasty letter and that will be in the record.

EXTENT OF AUTOMATION

Mr. SHERIDAN. Your chairman confesses to being a little confused at this point. If our exercise is to imagine only a fully automated system, it seems to me the last three columns of this matrix don't make any sense at all. The middle two have a good deal of automation in them. I am not sure the space station makes any sense because you might not even do a space station. Like your ship, I am not sure if you wouldn't create people you would even use a ship, you might do it in the water, in the air, you might do it some other way.

It seemed to me part of the charter was to think about as much automation as you could muster, but then see that in relation to partial automation.

Mr. BERGER. I think what you are looking at here—I think we are getting involved in semantics in terms of automation. We are not talking about automation in the sense of autonomous, completely autonomous action; we are distinguishing the amount of man involved. I think the intellectual exercise is to start with the concept, which is the first column on this matrix, to what extent can we fully automate these 10 functions and where you find you got a blank here and you can't do it, you move to the next level, to what extent can that be done with telepresence and then to what extent you need human visitation, and then, finally, to what extent you need people on-site 24 hours a day.

Mr. SHERIDAN. I am happy.

Are you happy, Ruzena?

Ms. BAJCSY. That is exactly what we do at the university. We say, let's put all the balloons in the blackboard, what can we do in 1 year, 20 years, that is what research is all about.

I am an engineer and we say, what can we do and what can we simulate, what can be done only by humans and what can be built, and, finally, we do the experiment.

Mr. ROGERS. I think it would be helpful to all of us to understand and try to appreciate that there are reasons for putting men and women in space that don't have a thing to do with anything we are likely to talk about today, and possibly the basic decisions about whether or not to have humans will be made on those grounds so we don't need to be concerned about it.

TELEPRESENCE

Mr. TAYLOR. When you look at this matrix going from left to right, what you are going to say is: Gee, can we do without people altogether? If not, how little of a person can we get away with? There is another way of looking at it, which, I guess, you can say is going from right to left, where the question you ask yourself is not how do I replace a man, but how do I enhance the productivity of an astronaut to the maximum extent, how do I make this worker in space maximumly productive. I think the kind of answers you come up with are going to be totally different.

One problem I guess I have is that you can have a very highly automated manufacturing process that still requires a permanent human presence in the sense that you don't completely abandon having a machine operator on station, even though the process is still highly automated and requires relatively little human interference.

Now, telepresence is obviously a compromise somewhere in there. The other question I have is that I don't think we really got an answer to Tom's question about communication delay. If you are going to use TDRS, then it is going to be several hundred milliseconds of communication time.

Mr. ROGERS. I think the answer is twofold. The group delay could be as much as four-tenths of a second: up from the Earth to the TDRSS, down to the infrastructure, up again to TDRSS, down to the Earth. Then, within the packet, the impulse response will be the reciprocal of the 300 megahertz.

Mr. TAYLOR. Telepresence implemented through a delay is different.

SEMIAUTONOMY

One potential is to have a robotic apprentice. Suppose you have a task that needs reiteration 100 times. If you could teach that task using some teleoperator method of teaching and have a smart programing system build a sensing strategy, then the astronaut can say, "Here do this," and then go about his business. Now, that kind of automation is very different than something where the activity is completely automated to begin with. I don't know if that is again a point of order, but I do think that this kind of semiautonomy also should be considered rather than simply the question of whether we have to have a man here at all.

But there is the question, how do you use that man if you've got him?

Mr. SHERIDAN. We had a system like that for a dozen years in my laboratory. It worked and we are putting it in deep ocean right now, but it is highly automated still. So, I am glad you brought that up. There are ranges of automation that include people in different ways. But I do think for their sake it is reasonable and even though going from left to right and right to left does give you slightly different answers, we ought to ask ourselves in a reasonable way how much of this can we conceivably automate within a reasonable period of time because I think that is what they want. NASA's inclination is probably going to come from the other side to automate only where they have to.

Mr. RUOFF. I think the fundamental issue of whether you have a station manned or unmanned, staffed or unstaffed is whether or not it has to support human life forms. Being able to repair panels, repair slip rings in orbit, gear boxes in orbit, none of those things is very easy, even for humans, unless you have specific support fixtures. Whether or not we have people we are still going to have structures that are going to be accessible to other structures used for repair and maintenance. I don't think we can come up with fundamentally different ways of building mechanical things whether manned or unmanned.

Mr. SHERIDAN. Let me acknowledge that Charles Frazser just recently joined us a few minutes ago.

Mr. NITZAN. I would like to propose that any of these functions can be done fully automatically, depending how you define these functions. Their definition is very vague here but when you come to numbers and specifics then you can answer the question more specifically, and even under that condition, I think, these functions can be realized automatically, depending on the amount of money put in and the time.

So the basic problem, I would say, for each of these functions is to define what the research and development issues are and estimate what it would take in terms of time and resources to be able to achieve them, given that they have been defined in some way.

PLANNING HORIZON

Mr. SHERIDAN. I would guess we would have to give some examples because if we ask precisely what the tasks are, they won't be able to tell us. We have to say, for example, here is what we can do today and here is what we might be able to do 10 years from now.

Mr. NITZAN. Exactly. I would like to propose something. If you go to the last column in the table, going from left to right, you will find that there are many tasks that a human cannot do today and would not be able to do in the future, tasks that must have machine assistance. So, it is more in that direction that we have to worry about. For the past 25 years we have had autonomous machines in space because it was easier and safer to achieve the required tasks automatically than to put men there. Don't forget, the entire world would have been watching the astronauts performing those tasks and God forbid if any astronaut is detached from the spacecraft and drifts to infinity and everybody feels sick in the stomach about his feelings; to prevent such a catastrophe would cost too much money.

Mr. ROGERS. We have had many machines go into infinity and only the insurance company gets that feeling. There is a basic difference in our regard for a human being and a machine.

Mr. NITZAN. It is less costly.

NASA SPENDING ON AUTOMATION

Mr. ALBUS. I agree with David that all of these things could be fully automated, at least depending on how you define them and it does, in fact, depend upon the commitment of resources and financial and intellectual resources committed to this and the amount of time that is spent on it. That, it seems to me, is something on which the congressional staff here can, in fact, make a significant impact. This committee is asking questions of how much, and what percentage, of the NASA budget is committed to various things. From what I know of the NASA budget, if the percentage being committed to research in robotics and teleoperators is continued, it will be 200 or 300 years before the space station could be automated. It would seem to me fair to ask NASA to commit as much to teleoperators and robotics as they do to human life support systems. If that were done we might double or triple the total amount of money spent in the whole country.

Mr. HERMAN. Let me give you some precise numbers on the differences in the various segments of the NASA budget.

Between fiscal 1984 and fiscal 1985, the total research and development portion of the NASA budget increased by $197 million, that was from $5.8 billion to $6 billion roughly. The science and applications budget increased more than that, $238 million, from $1.134 billion to $1.372, that is an increase of 21 percent. The manned space flight budget went down $367 million, from $3.533 billion to $3.166 billion, a decrease of $367 million or approximately 10 percent.

The other major segments of the NASA budget are the aeronautics and space technology program which went up $53 million from $438 million to $492 million and the tracking and data program, which went up $123 million and that was primarily driven by the problems of the TDRSSS satellite that went from $688 million to $811 million.

Mr. VAN ALLEN. What portion of NASA's budget is devoted to advancing the state of the art of automation in space? I suspect that it is less than $1 million annually.

Mr. BERGER. Let me respond to that.

What Dan has done is outlined the broad proportion and allocation of funding. The question that you pose, as I understand it, given the space station design as now conceived and as will be developed, what proportion of it is devoted to advancing the state of the art of automation, what proportion is devoted to providing life support equipment for the astronaut, that is independent of comparing of the 1984 and 1985 budget?

I will tell you from my personal experience that when I discussed these issues with the Agency, and they showed me some of the exciting programs that are going on at Stanford and elsewhere, these programs tend to be of the 100 K variety, $100,000 projects that are going on to advance the state of the art. And given that $7.5 billion budget, that is not a very big proportion of it.

Mr. SHERIDAN. Nancy.

AUTOMATION CAPABILITIES

Ms. NAISMITH. I would like to reassure everyone again that we are not gathered here today to determine either the future of the space station or the NASA approach or how much money should go to who. This is not a "should" workshop. This is a "could" workshop. We are not in the should business.

Second, even though it is very difficult and we understand that since everyone has so much depth of knowledge in the room, certainly it is impossible to take these very simplified functions and try to mark a host of matrixes, nevertheless that is what we are trying to do. If we can think of these topics, we would like to know from the panel which of these areas are we closest, for instance, to be able to fully automate, which of these areas are we on a sort of threshhold where if there was a push in that area we might be able to make a lot of progress and which of these areas if we pushed on might we also see some important spin-offs.

If we can try to answer these questions just a little more simply—and we will miss a lot of points and we don't intend to do that, but that is what we most like to get from the panel, an order of magnitude, general feeling.

Mr. RUOFF. What are we supposed to put in the columns, a number?

Mr. SHERIDAN. It is sort of how far you can go if you imagine, the way I have been thinking, a kind of bar that starts out to be solid and gradually gets shaded and fuzzy; and I don't know what the matrix is, what it might be 8 years from now, it might be difficult in doing research or something of that kind.

Mr. BERGER. I think it is a narrative of what can be done, what can't be done at that intersection, what additional research needs to be done.

Mr. RUOFF. When? Ten years from now?

Mr. BERGER. I think that is part of the narrative.

DEFINITION OF AUTOMATED

Mr. SHERIDAN. I appreciate that, Nancy. I think partly what is hard for many of us to respond when you say that can be automated, it is not clear what you mean by "automated," because there is fully automated where from the time something is shot up there is no interaction from then on. There are degrees of reprograming or changing course or something like that. This makes a difference.

Mr. ALBUS. Again it comes back to when and that depends upon how many resources you commit to these activities.

Mr. CHANDLER. May I suggest we define as we go, making some remarks about cost in the possible schedule—those are related. But there aren't any rules here so you are going to have to do it as we go alone.

Mr. BROOKS. Jim, we are talking about low levels; that is, similar sorts of techniquest that are used where everything is not tied to the ground and what could be done in the foreseeable future, how much uncertainty could we deal with. We have to see what level of uncertainty we can deal with.

Mr. NITZAN. I think that for each of these functions we have to define the subfunctions that can be done today and, for those that cannot, what research problems must be solved and approximately how long a time is required to solve them—not in precise numbers, because none of us can do that, but within timeframes of 5 years, 10 years, 25 years, and beyond.

TIMEFRAME

Mr. SHERIDAN. In order to make it clear, should we talk about timeframes of being able to do things on Earth and let somebody else worry about how long it takes to make that space qualified?

Mr. RUOFF. Why don't we limit it to laboratory feasibility demonstrations that are robust and really work?

Mr. TAYLOR. I was going to say things like budgets. I remember that 10 years ago John MacCarthy, a professor at Stanford, was asked what it would take to make a completely autonomous machine and his answer was 3.1. Einsteins and two Manhattan projects. Well, the budget numbers we are talking about are two Manhattan projects, I don't know when we are going to get the Einsteins.

SCHEDULED MAINTENANCE

But, I was going to suggest that maybe we could take a task like scheduled maintenance, which is somewhat industrial and it is roughly in the middle of complexity and just try and do it. By scheduled maintenance do you mean on a satellite or on equipment in the space station? Let's assume for the moment that it is equipment and that you are talking about things like replacing consumables and, to some extent, troubleshooting, checking electronic equipment, and replacing components.

I think it is plausible to have that task very highly automated, especially if, for instance, the consumables, the refill places are designed so that they are readily accessible. For troubleshooting, I think that the answer is not so much an external robot but designing the electronic equipment with the diagnostic wraps built into it and so forth. I would be willing to believe that by the end of the decade 85 percent of that could be done because, again, you design the field replacement units to a standard interface that could easily be changed by a machine.

So, I would say that much scheduled maintenance could, in fact, be fully automated with additional inspection done through some sort of telepresence method.

The difficulty comes when your scheduled maintenance automation encounters something that you had not planned on encountering.

Mr. NITZAN. Time is running out and maybe we need some kind of structure to finish our task. One way of doing it is to talk about fully autonomous functions and ask about an approximate time for their implementation. The result will be a range of numbers and average values, not a consensus. I think the idea of taking the scenario is a good one, so we have a concrete domain to talk about.

Mr. SHERIDAN. My understanding is we are going to do a lot of that in our small groups.

Then we ought to take more time. I think all holding hands around the table is going to be tough to do too much. Probably we ought to talk as a larger group so we can get our heads on straight what we are trying to do.

My strong feeling is, I don't know whether you want to take a break at some point or not, that maybe we should get into those groups before lunch and get going.

Ms. EASTWOOD. Small groups don't line up very well with matrix.

Mr. SHERIDAN. The group will take a crack at everything.

RETRIEVAL AND DOCKING

Ms. EASTWOOD. The one thing I would think very helpful to have a group opinion on the 10 functions. Do we even agree which of these are the most far along and which ones the least far along? Russ thought the scheduled maintenance one we do short term. Assembly, that is very long term. I would be very interested to hear people's view. For example, I don't know a lot about retrieval and docking.

Mr. SCHAPELL. Laboratories demonstrating the feasibility of that autonomously.

Ms. EASTWOOD. I think it would be helpful which of these are pretty far along already.

Mr. SHERIDAN. Wally told me earlier that control meant control of the space station in a stationkeeping sense, not controlling in general.

Obviously, all of these things, every single one of them, to some extent is going to require both sensing and controlling.

Mr. SCHAPELL. The difficulty you are going to have here, many in the group are not going to be aware of things like we have laboratory simulations of fuel transfer. The retrieval and docking, these things are being contracted and worked on now fully autonomous.

We have been going through this and NASA has funded a number of studies in these areas. We would be interested to see what the group does think.

Mr. ARBIB. I would suggest that we simply allocate 5 to 10 minutes to each of these for information. I think each group should have some idea what people mean by each of these areas, so just get a knowledgeable person or two to indicate what they know about the state of the art in these areas.

Mr. SHERIDAN. I think that will benefit a great deal.

Controlling and stationkeeping in the stationkeeping sense, which strikes me to be fairly amenable to automation.

Mr. SCHAPELL. You mean going configuration of the vehicle. Here is where we got into the adaptable control system.

Mr. RUOFF. I think configuration comes under controlling.

Mr. SCHAPELL. The point is we have computer simulation but how much do you go into simulation.

Mr. TAYLOR. The point is whether you can build it or not. It is the kind of thing very plausible to believe that even with today's computers it is the kind of thing that a machine can do better than a man.

ADAPTIVE CONTROL SYSTEMS

Mr. SCHAPELL. But we are talking about adaptable control systems.

Mr. TAYLOR. There should be more research in adaptive control.

Mr. SHERIDAN. Right now it is automated once somebody on Earth pushes the button.

Mr. RUOFF. Yes. If people are building adaptive controllers. You can't deploy one of these structures on the ground and test it until it falls apart because they are too fragile. You can do some of the estimates. When you fly the thing and it starts to vibrate, the controller itself and system identifier change the control law so the thing remains stable. We have done a lot of work on that.

Mr. SHERIDAN. So the adaptive control part of maintaining.

Mr. BRADY. I would like to get your comment; there is more to control than just adaptive control. The Navy is interested and has funded several studies and systems where when a component breaks—for example, a valve on a heat pump on a ship—the system attempts to make more qualitative response rather than trying to solve a couple of differential equations. The system tries to figure out what are the consequences of an action: to shut down or turn down some heat and so forth.

STATIONKEEPING

To what extent is control in the purview of stationkeeping? Are we looking toward providing that kind of sensible response in a more judgmental way than would be provided based on the ideas of automating inference and figuring out the ramifications of some untoward activity; to what extent are we including that into stationkeeping as opposed to building more adaptive controller for a plan?

There is a lot of activity in that area. What I am trying to get is the sense of scope what is meant by stationkeeping? In one hand it can be narrow controllers and it can go through the most advanced artificial intelligence systems. I am trying to get a sense of scope.

Mr. SHERIDAN. If the latter is good, the answer is yes. At some point we would like to consider that.

Mr. BRADY. What do you do if joint 3 on the shuttle arm fails? Don't tell me you are going to solve that with adaptive controllers.

Mr. RUOFF. Machine intelligence is a control discipline.

Mr. BRADY. That is an unfruitful way to look at it.

Mr. RUOFF. I don't think so.

Mr. SHERIDAN. That does get us into category 2. These are all going to interconnect in some way. It is my impression that stationkeeping is largely automatic already and the people are not very good at doing this and it has been that way all along.

Mr. SCHAPELL. But they are brilliant structures.

Mr. SHERIDAN. All the more reason why it has to be automated.

Mr. SCHAPELL. The space station is different.

Mr. RUOFF. People can't fly the shuttle unless the computer is in.

Mr. SHERIDAN. Landing on the Moon was largely automated although the public doesn't think so.

Mr. RUOFF. There are a lot of cases where the green light goes on, if everything else is OK push a button.

Mr. HERMAN. That was the case of Apollo, not the shuttle.

AUTOMATED TROUBLESHOOTING

Mr. SHERIDAN. Troubleshooting or monitoring.

Ms. EASTWOOD. I would say monitoring is automated but troubleshooting is not and it is one of those designs for flight situations if you put in good diagnostic then it can be much more automated.

Mr. SCHAPELL. I think here you are talking about isolation. Marshal is contracting to have an expert system developed to do this sort of thing, at least for one major subset of demonstration initially, the par system. All resource management is another expert system that is pretty developed.

Mr. SHERIDAN. Incidentally, we can say far short of expert systems, there are automatic fault isolation systems that work in nuclear powerplants and aircraft.

Mr. SCHAPELL. These are under contract now.

Ms. BAJCSY. I am figuring a little ahead of time, maybe in the group we will have to do some work on the expert system. Who is doing them? What kind of expert? What kind of knowledge?

Mr. SCHAPELL. It is using the past system developed by Martin Marietta.

Mr. BRADY. I am aware of the work you are talking about. In fact, the Air Force and the Navy funded major projects, considerable numbers of RFP's.

The whole area of automatic troubleshooting and automated repair and maintenance is seeing enormous amounts of energy right now. The hard results are somewhat less forthcoming and the Martin Marietta system is one of the better ones.

Ms. BAJCSY. In your opinion, is there a fundamental reason that the results are not forthcoming or is it just the lack of time.

Mr. SCHAPELL. The thing that we are looking for is something useful and right now we are in the demonstration phase. We are increasing the results in time tremendously.

Mr. BRADY. There is another thing from the technical point of view. One of the things that you have to face is the business of modeling fairly complex systems at level of abstraction with different perspective and that is something which expert systems never have really addressed. That is a technical barrier.

Mr. TAYLOR. There is another aspect of that. If you are trying to build an expert system to troubleshoot a debugging system that wasn't designed for that, you get different problems than the problem of designing the system to have the troubleshooting and the monitoring built into it. This is something certainly computer companies have long had to deal with.

PROBLEMS OF ACCESS

The other aspect, when you start dealing with the mechanical systems, there may be problems of access that again the system ought to be designed so that you can be sure to get a look at every component that might fail. But again, I think when you get the automated, what you may find is that building all of that stuff into an automated system required you to have an android-like capability.

Mr. SHERIDAN. The difficulty is you sometimes can't measure certain things you would like to measure and you are reduced to analytical measurements somewhere else together with filling out the connecting transfer functions.

The other point has to be made in conjunction with these troubleshooting monitoring systems is that many of the ones that work are here on Earth in industrial plants of various kinds. If there is some ambiguity or if the system can't figure out what to do, it rings a bell or alerts a human operator. You always have to face that question to the degree to which you want to let that happen or be ready for that.

Mr. NITZAN. I assume that many functions in today's Space Shuttle are automated. What would help me decide how to achieve a fully autonomous space station is to find out in each of these functions what man does to augment the automation that exists today. With this information, I will know the functions we have to automate rather than going to see what we can automate today. The difference between what we must automate and we can automate today constitutes R&D issues.

Mr. SCHAPELL. I think we will be here all day.

Mr. NITZAN. It is longer to go and explain what you have already automated.

Mr. SCHAPELL. I understand. But maybe it is good that we are not going to do this because this way perhaps you will come up with new ideas.

Mr. SHERIDAN. Insofar as we can, we should do what you suggest.

Mr. NITZAN. Tell me what you already automated.

SCHEDULED MAINTENANCE

Mr. SHERIDAN. What about scheduled maintenance, we talked a little bit about that before. I thought we decided that was going to be one of the easy things.

Mr. AKIN. When Lockheed was inventing the space telescope for maintenance, they initially identified 120 or 130 orbital replacement units. When they went into the detailed design phase, the number of actual design ORU went from 120 down to 7 because they decided there was much engineering overhead in designing the unit to be easily replaceable. What they said was, "We know a lot of these units are going to be maintained on orbit. We are not going to design them to standards for orbital replacement, we will build them the way we always do and trust you guys to figure out a way to take them apart when you need to."

MAINTAINABILITY

Mr. TAYLOR. I think that is the key point in industry automation, you talk a lot about design automation, design for maintainability. In terms of spinoff, design tools, and just simply engineering doctrine or knowledge as to how to design things so that they are easy to maintain, maybe one of the great spinoffs of the space station, quality engineering——

Mr. SCHAPELL. Are you talking about standardization?

Mr. TAYLOR. Partly, but partly training your engineers so it is natural for them not to design things with 61 pinamphenol connectors.

Mr. AKIN. I think it would be very difficult to implement in the real world.

Mr. TAYLOR. That may mean scheduled maintenance is not going to go away.

Mr. ALBUS. It doesn't hurt to use standard screw threads.

Mr. SHERIDAN. Except you would like to get away from screwing nuts and bolts altogether.

Mr. ALBUS. What I am saying, standardization is not impossible. There are a lot of advantages if you design objects with the notion that you would like to be able to service them with a manipulator system. For example, you would have the design engineer come up with snaps or latches that can easily be actuated by a single motion with one hand, instead of with a motion that requires two hands.

FREQUENCY OF REPLACEMENT

Mr. RUOFF. You have to consider how often you might have to replace something. When you build a house you don't build it so you can take everything apart. If you have a severe problem like a broken pipe, sometimes you have to take a saw and cut a hole in the wall and that gets to be quite expensive and you replace it. If you did that every 10 years it wouldn't be too bad, but if you had to do it all the time, it would be expensive. It should be possible to use snaps and various kinds of mechanisms. You could imagine that changing a circuit board is one thing, while having to get in there and manipulate and disconnect the connectors on the back of the cabinet is another. It is easier to change the board than the connectors.

Mr. SCHAPELL. You mass produce things, yes. However, we are talking about a space station. It is all a function of what components of it you are getting to, if you are talking about satellites in general, theoretically it is possible, as you suggest. That was the theory behind the IOSS design. But in practice here we are talking about service to the space station. There is only going to be one of them with different modules and the standardization to three modules.

UNSCHEDULED MAINTENANCE AUTOMATION

Mr. SHERIDAN. Unscheduled maintenance, how far can we go with automation?

Ms. EASTWOOD. Not very.

Mr. RUOFF. It depends on how well you design the structure for maintenance. If you had an explosion and it dramatically changed the structural shape, even if you knew the intended shape from the data base, they would no longer coincide.

Mr. SHERIDAN. Fault tower on computers, for example, is unscheduled, it is anticipated but it is unscheduled. You have generic ways that circuits fix themselves.

Mr. SCHAPELL. The problem here is many things you could not possibly conceive of replacing. If you look at satellite, there is no way you can repair them.

Mr. ALBUS. There is no way astronauts can either.

Mr. NITZAN. I would like to know the functions astronauts perform for unscheduled maintenance.

Mr. TAYLOR. Oftentimes when you try to automate something you don't necessarily do it by looking at a way the person does it now.

Mr. NITZAN. The issue is where we need men to do unscheduled maintenance above and beyond what can be automated today.

DESIGN TRADEOFF

Mr. TAYLOR. Let's consider a generic thing that is often done in repairing things. There is a design tradeoff in designing something to take advantage of human dexterity and something designed to be taken apart by automated machine or by hacksaw. I think, realistically, it is going to be hard to change design practices so much in 10 years that everything can be taken apart and reassembled by automation. Even if you could do it you lose the freedom to design things to take advantage of human dexterity in their construction.

Mr. RAIBERT. Your company has gone a long way in building machines that can be taken apart by people with relatively few parts at assembly level.

Mr. TAYLOR. There certainly can be a lot of progress.

Mr. JACOBSON. You want to make the whole space station disassembly a simple thing. If you just deal with dexterity, then all of these problems get simpler. At some point it gets simpler to deal with dexterity than it does to design 10 years into the future with everything being taken apart with a simple tool.

Mr. TAYLOR. I am sure you would be happy to say we should be doing research in dexterity.

Mr. BRADY. There are two aspects of this. One is the business we have been addressing, which is how do you provide a general object that can perform those kinds of changes like, can you build a system that goes and fixes the solar panels on the Shuttle. There is a second aspect which is: what kind of model. One of the things that we ought to address is the state of the art, how do you come up with a suitable model that will function on land or some device or mechanism within a space station and how do you come up with an appropriate model of the anticipated behavior and changing behavior.

Second, we need to know there was going to be a radical change in behavior. If you are going to be able to deal with something like radical change, you must have a model of it. That seems to me to be much more difficult than to be able to reason in the way Steven is asking for in effective flexibility—namely, flexibility, dexterity, versatility—this is a tall order.

ASTRONAUT EXPERIENCE WITH UNSCHEDULED MAINTENANCE

Mr. SHERIDAN. Can we say, in general, that the farther you get from the normal configuration of anything the less able you are to model.

I wanted to ask our NASA people, on this unscheduled maintenance business, what is the track record for astronauts doing those things?

Mr. HERMAN. The Space Science Board meeting, Mr. Owen Garriott——

Ms. NAISMITH. Please speak louder; we can't hear you.

Mr. HERMAN. At the Space Science Board meeting, Owen Garriott gave a dissertation on the experience of Skylab as to how many experiments would have failed if there were no human operators on board to intervene and fix them. And there was a similar situation in the most recent Spacelab mission of the Shuttle.

There were quite a few anomalies which were unanticipated where if there were no human operator on board, the complete science would have been lost; but because there was a human operator on board they were repaired in time. There is a track record of that and a very favorable one.

Mr. ALBUS. The question that we should be addressing here would be what percentage of those cases, if you had a dextrus intelligent, sensor-driven manipulator on board, could the manipulator have done the same activity?

Mr. HERMAN. I think that is fair. Taking the lens out of the camera is one of the things that went on; it is something you have to determine how to do.

Let me give you one example of one other element in this that has not been discussed—the Voyager scan platform lookup during the Saturn encounter. Because of the long transit time between Saturn and Uranus, it was fairly easy to rewrite the program to use the attitude precession capability of the spacecraft in one dimension and to use the platform articulation capability in the other dimension to still get the encounter sequences of the Uranus satellites. If that hookup had occurred when the spacecraft was just encountering Saturn and approaching the first moon, all imaging science would have been lost.

MATERIALS HANDLING

Mr. SHERIDAN. Let's move on, materials handling and transfer within station. Is that something——

Mr. NITZAN. That is done in industry all the time. Our research has focused on this function. Each one of these functions entails another issue, which is design for automation, design for the limited capability.

Mr. SCHAPELL. There are designs for materials handling using robotic systems on the various NASA studies. You have to describe the function.

Mr. ALBUS. But there are different materials and all have different ways of handling. Picking a box from one cabinet and putting it into another is one form. Tying a shoelace is another form of materials handling. They are quite different.

Mr. SCHAPELL. The problem is biological experiments that have materials handling and it is not practical.

Mr. VAN ALLEN. What kind of things?

Mr. SCHAPELL. Perhaps you are going to do a vein graft or that sort of thing.

Mr. VAN ALLEN. Doing surgery?

Mr. HERMAN. The basic procedure is that the next step is a functional capability which depends on the reaction of the specimen and the reaction time is very short.

Ms. BAJCSY. Speak louder.

I would like to understand for the subgroup what kind of materials handling you want us to think about because that very much will determine what kind of representation we have to be talking about.

Mr. SHERIDAN. Some would be solid objects, some would be fluid, some would be soft goods like cloth, and some would be these biological things which are difficult.

ANTICIPATED REQUIREMENTS

Ms. BAJCSY. Do you anticipate biological experiments, psychological experiments, factories, everything?

Mr. SCHAPELL. Yes.

Ms. EASTWOOD. My question is whether or not most of these materials handling is planned in advance, are they well known? I think that would be my biggest concern, whether you know full well you have to handle them and then you can plan for them and do it better.

Mr. VAN ALLEN. That is true. You could knit a sweater.

Ms. EASTWOOD. As long as I know in advance.

Mr. SCHAPELL. We have looked at a series of experiments and many of the experiments are very long term where you have to periodically interact with it and others are very short term, and so forth.

Ms. EASTWOOD. But it is well defined and known in advance?

Mr. SCHAPELL. Nothing is well defined about the space station yet, but you can come up with examples of what you might want to do. We had situations in the past with various user communities.

Mr. SHERIDAN. What you are saying, it will be well defined?

Mr. SCHAPELL. No, you cannot project the experiment sets that you are using. We can only go out in so many missions in the Shuttle, identify an experiment in the second flight of the Shuttle, and the thing we can't project that far ahead the experiments of university students and even high school students that you may want to interact with.

Mr. ISLER. If you know you may not be able to automate it. This is the case if we know what we want to do before we leave the ground, then this is potential payoff area because in trying to automate or do experiment systems, materials handling or materials process, they would, these are areas of research right here on Earth that we are trying to know how to do. It would be rather ambitious to say we are going to do this out in outer space. This gets back to David's point where I think that somewhere—maybe not today—we do have to compare what the humans now do and determine which one of those functions we want the machines to do. I think you can't get away from that to define the problem.

FLEXIBILITY OF SYSTEM

Mr. ARBIB. The issue is one of how flexible the system is going to be. We know that in assembly lines we can come up with special materials-handling devices that are larger than any robot but excellent for assembly line function. However, if we are talking about one of a kind assembly, we have to go to dextrous hands. We may want to have parts available that are not tied to only one assembly. If we are talking about materials handling for a range of tasks, we may want to have some place available for magazines. We get into transportation problems versus the manipulation problem.

My feeling is that, as we go from the specific tasks using rigid objects to a system where we have nonrigid assembly from different magazines scattered throughout the station or where we have a variety of different repair tasks, then we are talking about a major step in artificial intelligence and that at least a 10-year basic research effort is required.

Mr. RUOFF. A lot of materials handling exists; it is hard to say which is which. In factories you always have people watching. Conveyor belts don't have any sensors on them. People have been known to sabotage belts. The reason they work is that you have all these sensory devices called humans walking up making sure the belts not screwing up. If you want to be automated, we have to have an extremely sensor-based system or it is not going to work at all. That is a fundamental issue. Washington was built by people using their hands driving nails and inserting screws, using probably a fairly small number of primitive operations. The big research issue is going to be in separating those sensing modalities to do robust manipulation on a small scale, and I think you can extrapolate that to building more and larger things. It would be a show-stopper to be able to execute those mechanical primitives in real time using sensory information.

Mr. NITZAN. We have done a lot of research in materials handling for industry and there is one big difference between what we are talking about here and in the space station. In industry the number of times you have to handle the same type of materials is comparatively large. The cost factor of material handling is much more important in a space station because expensive part presentation devices cannot be justified for small-size batches.

SENSING AND COMMUNICATING

Mr. SHERIDAN. No. 6. Sensing and communicating.

Mr. BRADY. Just a brief comment on sensing. There are two issues that particularly need to be addressed here, one of which is the tradeoff of special aptitude of a particular sensing modality to a particular task; for example, infrared. And the tradeoff of those kind of special-aptitude sensors which are relative is circumscribed.

And the second thing which must, I think, be a major problem, and which only now work is beginning to be focused on, is the problem of sensor integration. In any practical system, you are going to have multiple, more or less trustworthy sensors giving information to different perspectives and giving those into a coherent picture in which you can base action. This is a major research topic item in the next decade in robotics.

I think those are important issues. At least we do have something fairly coherent in sensing.

COST FACTORS

Mr. TAYLOR. It gets back to something earlier. I was wondering, what is the expected cost of the first astronaut and the marginal cost of each successive astronaut in a station?

Mr. HERMAN. I can't give you a precise answer. Luther Powell can give you a better assessment. It has to do with developing the pressurized module. Once you do that, then I think the cost of replicating those modules is considerably less.

Mr. TAYLOR. Are we talking $1 billion for the first and $100 million for each successive one?

Mr. SHERIDAN. The question is, what is the cost of the first astronaut and the marginal cost of each additional astronaut?

Mr. HERMAN. Given the fact you are going to have man in space on a permanent basis, what is the cost of providing a pressurized life support system to sustain them, and then if you add additional astronauts, what is the cost?

Mr. POWELL. This will be permanent, not a visitation basis. There will be very little cost difference between the permanent and visitation. I hate to try to give you a precise number because you must consider that there are many resources there which are required by the things you will do, and to provide support to the man.

There are ways you can support man that are expensive and there are ways that are inexpensive. The Shuttle was chosen with the most inexpensive cost——

Mr. TAYLOR. Rather than all of this, can you give us an order of magnitude? Are we talking about a billion dollars or are we talking about $100 million?

Mr. SHERIDAN. Are you interested in relative numbers for the first versus the second?

Mr. POWELL. The space station is made up of modules. There is a resource module from which you draw all of the resources necessary for the total activities including support of man. If I add to that one module just to support man, that is a delta cost, that is less than $1 billion.

Mr. TAYLOR. So it costs you about 10 percent of the cost of the program directly related to——

Mr. POWELL. I don't want you to draw that conclusion because next there are laboratories that you add to it to do the things that man would do that are going to add to that total cost.

COST OF MANNED VERSUS UNMANNED LABORATORY

Mr. TAYLOR. What is the difference in cost between a laboratory that is going to have a man and one that is not going to have a man in it? How much do you pay? Here is where we get into telepresence and automation. Suppose you are planning to have men on the station. Now, if you go to build another module you could build that as unmanned module in which visitation is done in spacesuits or you can build that as manned module in which there is a shirt sleeve environment.

I am trying to get an idea of where there are some problems. We used clean rooms as an example last night. It is very expensive to have people in clean rooms because you have to blow a lot of air through them and people having access to clean rooms is very important because sometimes there are some things you can't do by automation.

Mr. POWELL. Let me explain how we have initiated this one versus additional crewmen. The station right now predicated $8 billion cost on a standardized module, which is called a common module. That common module is much like a motel room; it has standard lights, air conditioning, eating facilities, et cetera. You then outfit that room the way you were told you were going to utilize it. From a common module I can make a laboratory or I can make a habitat. So if I start without that common module approach, the cost is going to be larger. But if I am going to use the common module design to add a laboratory for the man to utilize, I will have minimal cost.

Mr. TAYLOR. In your initial design in that module, what would be the difference in cost, depending whether you design the first one to include the man or not?

Mr. POWELL. Totally unmanned, I wouldn't have a laboratory module if it didn't have a man. I would have a resource module and a platform and I would only have a visit capability in pressurized suits—as opposed to a flexible, manned laboratory—on a short-term basis. Those are two entirely different kinds of worlds.

Mr. TAYLOR. What are the manufacturing costs of one bare hull?

Mr. RAIBERT. The answer doesn't exist.

Ms EASTWOOD. All he has to do is not justify the cost of possessing the money or investing the money. All they ask is, could we do it. The answer: Sure, but they didn't ask us, is it a good decision to spend the money on more sensors rather than add two more astronauts, they asked us, could it be done.

Mr. NITZAN. That was the purpose. We are trying to focus on the "could," not on the "should."

SENSING

Mr. TAYLOR. I guess what I was trying to understand is the kind of thing that you might actually want to do. What kind of automation actually would make sense? Certainly the area of sensing seems important.

Mr. ROGERS. The basic design would have to be a lot more reliable. If you lose some of the equipment on a platform you are going to be troubled but not as terribly as if it were a human being.

Mr. NITZAN. On the other hand, there are things you rely on man to accommodate if there is an error, so there is a tradeoff. You put more into the reliability to the support system that safeguards man, but if there is no person there, then there is a need for more redundancy to safeguard the autonomous operation.

Mr. TAYLOR. I am sure I have got us off the topic, but I wanted to indicate that sensing seems especially important because human real time interpretation with the short loop of your sensing and active looking and feeling seems too important in getting information.

Mr. NITZAN. In terms of sensing, I see a lot of similarity between sensing inside and outside a space station and what are they doing now for the industry. Since you know what to expect in a spaceship, you can model its "would" much easier than if you didn't. Outdoor scenes, on the other hand, are much less structured.

A satellite has limited configurations and so it is very similar to an industrial work station.

Mr. BRADY. It seems to me if you are going to provide any kind of flexibility, you are going to have to be able to base sensing strategy and recognition on geometric modules. That is something we would like to do.

Mr. NITZAN. In outdoor scenes you can have many surprises, much more than in a factory or in a space station.

GEOMETRY OF OBJECTS

Mr. TAYLOR. How soon do you think there will be a modeling system that can model the physics of objects or even the geometry?

Mr. BRADY. The geometry has been a pretty interesting one. They are all tentative steps, quite a long way to go yet being able to deliver the kinds of geometric models that are now used for design. And second of all, on the basis of existing geometric models to be able to plan intelligently some perceptual studies.

Mr. BROOKS. If we are going to talk about "could."

Mr. BRADY. I think we could. We are in good shape.

Ms. BAJCSY. I would say 3 years, 5 years absolutely.

Mr. NITZAN. I would say that by the end of the century if we may have reliable vision systems.

Ms. BAJCSY. For point of information, in addition to the standard sensors that we have in our living rooms or household robots, other sensors one should consider in space, for instance for cosmic rays, especially for outside of the spaceship, I don't know what other sensors one should be concerned with.

Mr. HERMAN. That is a good point. We should look at all elements that would lead to enhanced efficiency and doing functions in an automated fashion. Those are issues that we really need to address and plan to address starting with an effort in a month or two. As a matter of fact, there is a work statement that we have generated that Dr. Berger has reviewed and we are in agreement. It has to do with the spectrum of endeavors, looking at new computer technologies, what software is required, all facets.

COMMUNICATING

Mr. SHERIDAN. Can we move on here. Communicating, I think it almost goes without saying that is already automated.

Mr. ALBUS. That is not entirely true. If you are talking about a space station that has 15 or 20 robots and 35 or 100 computers, communications problems are not yet solved.

Mr. SHERIDAN. But you are not going to replace that with astronauts. Aren't you obligated to automate to mechanize?

Mr. ISLER. There may be a technology void.

Mr. NITZAN. There is no disagreement between what both of you are saying—he is saying that it should be automated and you are saying that there are still some problems to be solved.

RETRIEVAL AND DOCKING

Mr. SHERIDAN. Sure. Retrieval and docking; what could we do there?

Mr. SCHAPELL. Obviously we are going to retrieve solar maximum. There are some studies ongoing, some completed, to determine feasibility. I mentioned earlier that we have a physical simulation flying, autonomous flying to end docking system which were ongoing at Marshal in that area.

Right now it appears for the near term that autonomous ongoing docking is feasible. We have looked at many different things.

Mr. VAN ALLEN. It is something like a butterfly net?

Mr. BRADY. You just catch them.

Mr. SCHAPELL. Right now if you come to our laboratory and you watch the physical simulation of a 6-foot-long simulator and the astronaut fits into this cage and the solar maximum spacecraft is spinning at relatively slow rate and he has to attach this device so the RMS, the Shuttle arm can pick it up.

COMPUTER-AIDED SIMULATION

Mr. SHERIDAN. Do you do this mechanically or by computer?

Mr. SCHAPELL. The astronaut?

Mr. SHERIDAN. The simulation.

Mr. SCHAPELL. The astronaut is actually flying the simulated machine within the laboratory.

Mr. SHERIDAN. Given that human person is doing it, but is the simulation done by the computer?

Mr. SCHAPELL. Computer.

Mr. HERMAN. It is a moving base simulator.

Mr. SHERIDAN. It is not done in the computer?

Mr. SCHAPELL. The computer puts it into effect.

Mr. SHERIDAN. But you don't have the human?

Mr. NITZAN. It is computer aided.

Mr. SHERIDAN. Other than the human subject himself, why don't you do the whole thing computerwise with the computer graphic display?

Mr. SCHAPELL. We have to address reality and we are trying to simulate as close to the actual mission and train the astronauts. Are you asking me why don't we automate the whole process?

Mr. SHERIDAN. No. I am aware that having zero gravity in something earthbound is difficult and I am asking you what the state of the art is, your judgment, as to using computers to get rid of gravity in simulation.

Mr. SCHAPELL. We do that quite well in terms of when you make contact with the vehicle, even when you attach the astronaut to the spacecraft you change the inertia of that vehicle. Obviously you can't reproduce it for human except for the new component. I think we have high-fidelity system. In both cases the astronaut maneuvering and now the machine maneuvering unit. Our simulations are very close proximities to the real thing.

Mr. NITZAN. This function of retrieval and docking entails serving with some kind of sensory feedback. It seems to me that that task ought to be automated. Wasn't the landing on the Moon essentially automated?

Mr. HERMAN. Yes.

Mr. NITZAN. I saw what your company did for NASA's center at Huntsville in essentially solving a peg-in-the-hole problem.

Mr. SCHAPELL. The world is different now than 5 or 10 years ago. Now we can bring the two vehicles in close proximity where we understand the proximity of those two vehicles.

Mr. TAYLOR. What is the astronaut doing? Is he flying out there and bolting and handling things?

Mr. SCHAPELL. Essentially.

Mr. TAYLOR. Why can't they have this system built into the spacecraft?

Mr. SCHAPELL. They didn't expect this to happen.

Mr. TAYLOR. Concerning the questions of dextrous manipulation and stationkeeping, aren't some of those control functions? Wouldn't it be more effective to have a computer manage the burning of the little jets to do the stationkeeping?

Mr. AKIN. Basically they will load the inertia properties into the control system.

Mr. TAYLOR. So that is the case where a completely autonomous system would be doing the same thing. What we are really considering here is the question of whether you need some kind of dextrous device to do the part of the retrieval function.

Mr. SCHAPELL. The reason we are doing this, we don't have a fully operated retrieval system, we have no other way of doing it.

ASSEMBLY PROCESS

Mr. SHERIDAN. Let's move on. I think we more or less decided in terms of "could." There is no question that retrieval and docking could be done, but sometimes when you got the human up there, it is easier.

No. 8, assembly. Very interesting question, those of us who fiddle around with assembly.

Mr. NITZAN. We are talking about different kinds of assembly. We are not talking about assembly consisting of making small parts or to a product. We are talking about assembling long components of a large structure. The cost of transporting the components to outer space and assembling them there is much lower than assembling them on Earth and transporting the structure into outer space.

Mr. SHERIDAN. That is one of the things.

Mr. HERMAN. Not only cost effective, it may not be feasible. One of the things looked at is the assembly of very large apertures in space that physically cannot be carried up in a Shuttle.

Mr. NITZAN. Is there any other kind of assembly?

Mr. RUOFF. Assembly to fix something.

Mr. SCHAPELL. You can manufacture the beam in space. There are some contracts in that area where you actually manufacture the beam, unbend it and it becomes a rigid structure and the other one where you take this kit that you have in the back of the Shuttle and it may take six flights for one portion of the structure and you unfold it and you assemble it.

Mr. ALLEN. Shouldn't that word be construction?

Mr. BERGER. It is sort of macro level.

Mr. TAYLOR. Are we talking about welding and riveting?

Mr. AKIN. Using mechanical connection.

Mr. RUOFF. That is still assembly.

Mr. NITZAN. The moment of inertia of these parts is large.

Mr. RUOFF. And the flexibility is large.

Mr. NITZAN. These parts are not rigid.

Mr. SHERIDAN. The effect of the moment of inertia goes to zero as it goes slower.

Mr. BROOKS. Holding something down here and the forces happening way up there, what does that do? What sort of sensing and how much sensing is needed to do this?

Mr. NITZAN. Two operations—you use a rough manipulator to bring it to the vicinity of the target so you can sense it and then you measure the error and correct it with a more precise manipulator.

Mr. BROOKS. You need a little rocket pack sitting at the end of the beam to do the adjustment.

CONSTRUCTION

Mr. TAYLOR. It seems like we are talking about construction. You are dealing with rather specialized machines. You have a machine with two beams and another machine that grabs two ends of the beam?

Mr. SHERIDAN. Sure

Mr. TAYLOR. What do people believe that humans would be doing in construction? What is the progress that you are talking about or that is believed?

Mr. AKIN. If you are talking about construction, you have the particular task of people manipulating a large mass or high moment of inertia, the actual connection process. There are also a lot of things that involve strategic planning: how do you assemble the structure, in which order and which section do you assemble next; but it is not a derministic task. Generally speaking, the parts that are used are in the same location or scattered in a few locations. In human assembly, you spend about 30 percent of your time in the actual task of alining and connecting a beam, 20 percent of your task in translating and so forth, you spend a substantial amount of time in retrieving elements from stowage. There is also a nonnegligable amount of time figuring out what the next section you work on is. Unless you want to have a totally deterministic script written before the assembly process, there is a lot of planning and learning to be done on how you best approach this assembly, which parts go first, which parts second.

Mr. TAYLOR. After you get the structure, don't you have to wire it up? What proportion of construction work is in the detailing?

Mr. AKIN. At least 50 percent. There are different kinds of automation required for that.

Mr. SCHAPELL. There are many ways attached. We run simulation in our own facilities, some unfold very nicely and others get hung up.

Mr. TAYLOR. You build the structure and now you have to put some fittings on it?

Mr. SCHAPELL. No, it may unfold and rigidize. A typical request for one structure that we build would be a cube that we build which is made up of 25-foot sides and we unfold them. It is in tension like a spring device and whatever contractor you want to talk to has its own way of doing it. But once they unfold, they are relatively rigid.

Mr. TAYLOR. Everything is all wired up and simply folded but there is nothing about extruding beams. Once you fabricate the structure, do you need to add additional items or is it completely prefab?

Mr. SCHAPELL. The space station is being used or even part of the space station. You may extrude a beam, it may go together like an erector set or Lego blocks.

Mr. SHERIDAN. We have 14 minutes before we are supposed to go to lunch and there are a couple of administrative things we have to do before we go to lunch.

Mr. NITZAN. It looks to me like there are similarities between this type of assembly and construction of a tall building. You start from the ground and as you keep going up you use a platform for the people to work on. As you keep on building a long structure, you need a mechanism for the robot to reach the place where it can do the job. This task entails a mobility problem that can be solved by using magnetic feet, shoes, or wheels that will be able to attach themselves to the structure as they reach the target. Access is another problem, and here mobility and access are mixed together.

SATELLITE REPAIR

Mr. SHERIDAN. Satellite repair which is listed here separately from maintenance, it is similar to No. 4. I think what makes it different is that we are out away from the space station.

Mr. BROOKS. The satellite is not.

Mr. SHERIDAN. We are saying that is proably more difficult. It will involve sensing, it will involve docking, it will involve a lot of things.

Mr. BERGER. Unless it was satellite-scheduled maintenance.

Mr. NITZAN. No. 4, unscheduled maintenance, is very similar to this one; I don't see much difference between them.

Mr. BERGER. The only reason it was listed separate is it is external from the space station and may be connected to the space station during the time of repair is going on, but you may need something else to deal with this problem.

Mr. NITZAN. Design for automation is very important here—you want to be able to simply remove a module and replace it.

Mr. SCHAPELL. That is what we covered earlier. We would like to have all these modules but you never quite get there.

Mr. NITZAN. What would the man do if that were the case? You knew there was going to be a man.

Mr. SCHAPELL. No, we did not know. We never planned for that repair, that was something that we came up with after.

PRODUCTION

Mr. SHERIDAN. What about production. Of what?

Mr. TAYLOR. Solar manufacturing.

Mr. SHERIDAN. I think we are talking about factory activities, all the problems you have.

Mr. NITZAN. Materials handling.

Mr. SHERIDAN. It might be fluids.

Mr. ARBIB. Routine operation and, therefore, most of the planning can be done on the ground beforehand and when you get to scheduled maintenance for the production system.

Mr. BAJCSY. I want to understand the problem. Does anybody know here, especially the NASA people, what plans, in what forms are the materials you are planning to bring for this production? For instance, is it raw materials, is it going to be something that ignites, or is it something that you are thinking in manufacturing in a vacuum.

Mr. HERMAN. Let me discuss one process that I am little familiar with and another one that recently NASA assigned a joint endeavor agreement with 3–M. The one I am familiar with is using the electrophoretic separator in zero G to separate biological pharmaecutical materials in space—a process which is totally impractical to do on the ground. The assessment of the people involved in that area is that it can be automated, once the process is known and defined. But where you need man is in developing new pharmaceuticals, new processes where you must experiment in zero G with the electrovertic separator. The materials, as I understand, are essentially delivered in liquid form.

Mr. TAYLOR. What is the person doing?

Mr. HERMAN. The person is doing a function of the reaction and separation rates.

Mr. TAYLOR. Is he turning knobs, is he using his fingers to test the batter?

Mr. HERMAN. My understanding is he is injecting different kinds of materials as a function of the observation.

Mr. TAYLOR. The point is that the equipment and handling there could be highly automated.

Mr. HERMAN. It could be, depends on the reaction time.

Mr. TAYLOR. You may still have a man in the loop deciding what is going to be done, but he doesn't have to be doing low-level control.

Mr. HERMAN. He may have to. It depends on the time constance of the chemical reaction.

Mr. ALBUS. Does the guy have a syringe, does he flip a switch?

Mr. TAYLOR. If you are going to have automated production, one thing——

Mr. HERMAN. If anyone is interested in this, I can have the experts that are involved in the one process that is being used in the shuttle now that is evaluated by the FDA for commercial use, describe in detail the nature of the process and where man fits in. I am not an expert.

Mr. SHERIDAN. Let me encourage you, then, in discussing these in your groups to make some assumptions about the nature of the task we won't know specifically.

HOUSEKEEPING

Mr. ALBUS. Could I add one more item function to this list? How about housekeepihng?

Mr. SHERIDAN. What do you mean?

Mr. ALBUS. Cooking, doing laundry.

Mr. SHERIDAN. Housekeeping for astronauts, for the machine?

Mr. ALBUS. For astronauts. The first question is, How much of the human astronaut's time is spent in housekeeping chores.

Mr. BERGER. The model assumes that about one and one-half people are required on a daily basis to maintain the station and the system associated with the station. That does not include the operation of the experiments.

Mr. SHERIDAN. Can't we call that scheduled maintenance?

Mr. BERGER. We could.

Mr. ALBUS. It seems to me that would be a good candidate for automation.

SUPERVISORY CONTROL

Mr. SHERIDAN. Why don't we add that and if any other functions come up, as you think about this, add them.

Incidentally, let me make a suggestion. I have grown increasingly uncomfortable about having a category called fully autonomous and having another category called telepresence. For most it implies a more or less monitoring availability from a human on the ground and it seems to me there is a category squarely in between which I would call supervisory control which means intermittent monitoring and updating of a computer program if the person is not there.

Mr. NITZAN. There are several levels.

Mr. SHERIDAN. Yes, but if you want to spread human telepresence over a wide range, OK, but I want to make sure—I am not sure the bureaucracy still understands the possibility here.

Mr. NITZAN. There is an item in between fully autonomous and human telepresence in which the human maintains supervisory control and determines what needs to be done. There are certain functions he cannot do as well as a machine so he switches to automatic, like a pilot does, and later he switches back to manual. That is where the optimum use of a man/machine team comes into play. I don't know under what category it falls.

Mr. SHERIDAN. When you switch to manual you are doing telepresence. It seems to me with the possibility of occasionally updating a computer program by giving high-level plans you may not ever fall back on what you think of as master slave telepresence.

Mr. NITZAN. I am talking about functions that are done much more easily if the computer takes over and everything is automatic. If something goes wrong, however, then man can step in and do something about it. I don't know where it falls.

Mr. SCHAPELL. Under fully autonomous there are levels of that that we have not considered from the intelligent autonomous.

Mr. SHERIDAN. There are levels of fully autonomous? I thought fully autonomous was fully autonomous. I think there have to be some stages in between.

Mr. SCHAPELL. You can automate many processes; then there are eventually those you would like to go to manual and these are where your sensory perception and intelligence comes in.

Mr. NITZAN. It is very easy for a man to teleoperate an arm to come close to a target, such as bringing a peg into the vicinity of a hole, but it is very difficult for the man to control by teleoperation the insertion of the peg into the hole. At that point the man switches to automatic and uses robot sensing to insert the peg into the hole. Under what category would this fall?

Mr. SHERIDAN. I would like to put in there what we call supervisor control.

Mr. NITZAN. If we can regard periodic human visitation as periodic human control or supervision, all we have to do is——

Mr. SHERIDAN. I think they mean really humans physically.

Mr. BERGER. If you take the second one and modify it and call it human intervention or telepresence where you take intervention to mean command and control.

WORKSHOP ADMINISTRATION

Mr. SHERIDAN. Let's regard this spectrum and deal with it.

Now we have one little administrative matter. There were a couple of people who did not make it yesterday whom we had originally scheduled on our groups. I would like to ask Mike Arbib if he is willing to move into the models and knowledge representation. I think that is pretty close to your interest. And Marc Raibert to move in the sensing, interpretation, and navigation category.

Mr. RAIBERT. That is fine.

Mr. SHERIDAN. I think if we do that, we are pretty well balanced. Our thought was you would meet together at lunch. We will ask somebody to make a presentation along about 1:30. Phil and I will circulate to some extent and see how you are coming, and if you need a little more time you can have a little more time, because it is important that you get something in writing.

Mr. RAIBERT. I would encourage people to put some thought in estimating how much work is required to bring something to fruition in man-years or research. We are trying to evaluate the relative cost of using people to do these things.

Mr. TAYLOR. Can you also estimate how many fundamental new ideas are needed?

Mr. SHERIDAN. I think in each area we need some discussion of where we are, some discussion of what it takes to get where we would like to be, and some qualifications, all of those things.

Before we go to lunch, there are two new members that came in. I wonder if you could introduce yourselves.

Mr. WEINGARTEN. Rick Weingarten, Program Manager, Communication and Information Technologies, OTA.

Mr. NEIF. Fred Neif with Lockheed Missile and Space Co.

WORKSHOP RECESS

[Whereupon, at 12:05 p.m., the luncheon recess was taken, to reconvene at 1:30 p.m. the same day.]

(AFTERNOON SESSION, 2:25 P.M., MONDAY, MARCH 19, 1984.)

WORKSHOP ON AUTOMATED SPACE STATION

OPENING REMARKS

Mr. SHERIDAN. Could we take our seats? We are waiting for a couple stragglers, but I think we ought to get going in any case.

We have a new reporter. I would ask, again, would you identify yourselves when you speak. I think we are going to give each chairperson of the subgroups a few minutes to make a report, and then we will have reactions and questions.

We would like to finish these within the hour. So I hope your reports don't get too long-winded, and we can ask you a few questions and get on with the next one.

Who is ready to go?

Margaret, if you could begin, that would be fine. This is the group on kinematics, dynamics, mobility, and low-level control.

KINEMATICS, DYNAMICS, MOBILITY, AND LOW-LEVEL CONTROL

Ms EASTWOOD. We were table 1 and we did have these as our particular topics. The first thing, we spent half our time deciding how we were going to constrain our part of the problem, and we did come up with a conclusion that we were going to specifically concern ourselves with those parts of the task where we were doing physical interaction with some part of the space station or its environment. We did not address anything that we considered somewhat higher level such as path planning. When it said "low-level control," we took them at their word and did only address low-level control.

We started on the matrix and found from our standpoint at such a low level there was a lot of redundancy, and so we postponed working on the matrix until we set up a particular scenario and, in this case, we postulated that there would be interior robots. I use the word "robots" loosely as some sort of mechanical device. There would be interior robots and exterior robots, and the exterior robots would be subdivided into two types: those which are attached to the space station in some way and those which are free flying, such as you need to, perhaps, fly out and attach themselves to some other device.

We did postulate that and the other issue we addressed briefly was end effectors. We assumed we would have these things available to us to apply to all those topics in the matrix. If you start talking about our concept of what this interior robot would be, we designed one, and the one we designed would be on rails. We decided it should, indeed, be tied down in some way, and we took the current construction of most satellites that we have seen or space labs that we have seen, and we assumed this would be on rails and go down the floor or above the heads where it was to be out of the way of the people; that it would be dedicated only to this module.

There are some space stations that might have several rooms, if you will, and we assume the rails run to the end of that little module, and would have to hand the parts to the robot in the next room, so we didn't have to worry about getting through hatches.

We also assumed that the manipulator would be such that it could reach anything from these rails, and this might mean that it had to have little side rails to get to some places. We assumed, indeed, the arm was long enough and had enough bends in it that would reach places important to us.

We assumed it was storable and assumed it could run into multiple modes. It can, indeed, go autonomous or, if you put it into semiautomatic mode, people could interact with it from the ground or the station itself.

In addition to our general-purpose interior robot that is running up and down on these rails, we assumed that it might be very likely that you would have special-purpose robots for those planned tasks you knew prior to launch were going to happen. If you had a highly repetitious production task where you are feeding ballbearings or doing something repetitive, that you would not rely on your general-purpose, mobile robot, you would, indeed, suply a specific robot to do that task.

The same might be true for scheduled maintenance where you know you are going to have to have a robot that puts in—I don't know—new air cylinders every so often, so you would just dedicate a robot to that.

So those were our characteristics we felt this interior robot would have.

We came up with some characteristics on our exterior robot also. Because we were worried about such things as dynamics and kinematics, we felt when you are working on the exterior of the space station itself it was highly desirable that you be attached to it so that you had some stationary or stabilizing influence there. That could have been by several ways.

We have heard of concepts where you have what looks like great big scaffolding that sort of surrounds the space station and those are actually rails. Again, a mobile robot slides around this scaffolding that is on the exterior of the station.

Another possibility is that there are just attachment hooks every so often and that this exterior robot is also free flying until it gets to one of these hooks, it attaches itself to a hook and the working arm, while you have the grappling arm attached to the station, the working arm can work in some sort of a work envelope nearby.

The third one we had was the cherry-picker concept where some very large boom comes out holding the actual working manipulator. In all three of these cases, you are attached in some way. The alternative was free-flying mobile robot. We somehow had fewer ideas about that. We knew it would have to have some sort of thruster system, and it starts looking like a little automated vehicle here. But once it got somewhere, we again assumed it would attach itself to whatever it was working on. It didn't continue to free float after it got there. Those were some of the assumptions we made.

The end-effectors, we feel for planned tasks you know in advance there are some efficiencies for providing the appropriate end-effectors whether these be fingerlike or tool-type in advance. These would be in fixed locations. They don't free float inside the environment. They are in little tool holders so you know exactly where they are, and you can go get them as needed.

On the other hand, we realized there will be the desire to have general-purpose, very dextrous ones that will cover all unplanned activities. We assume they would come in large, medium, and small, and you would get the one that best fits today's unplanned task, the assumption being in all cases, whether planned and unplanned, that they would have a very high sense of complement.

We were extremely concerned about dropping things because once you drop them, trying to reget them is very difficult. So we felt that the need for sensors on the end-effectors was very high here.

We had some conclusions, before I jump to the matrix. Our conclusions were we had the easiest part of the task in that we feel the state of the art at this level is almost what you need already, and so we did not see really long R&D projects to do low-level manipulator control and kinematics. One of the things I forgot to tell you is we assumed the interior robot did, indeed, have rigid links. On the mobile exterior ones, we are not so sure. In fact, we are pretty sure the mobile exterior ones would have nonrigid—I guess is the right word—on links. Interior we assume it would have rigid links, therefore it is very close to today's state of the art.

The biggest topic becomes the control of the flexible arms because that can be difficult, especially when they are large and you get an oscillating effect. The biggest R&D topic we felt was integration of sensor input, whether this be visual surveying where the camera in real time is telling the arm where to go or some sort of touch sensor which in real time is giving feedback to the control which has not been done on a very wide scale to date. We felt those were the two big R&D topics that applied to our techniques.

Any question about our assumptions in general?

Mr. Brady. Does free flying include wire guided? There is a lot of experience regarding wire-guided missiles. It seems to me it would be an intermediate step between the two.

Ms. Eastwood. We didn't think of it.

Mr. Sheridan. What about wire-guided——

Mr. Brady. There is a lot of experience of using wire-guided for this kind of environment.

Mr. SHERIDAN. You can use optical fibers.

Mr. RUOFF. The control properties are still the same.

Mr. SHERIDAN. What about end-effectors, Margaret? You glossed over that as being, maybe, fairly ready now? Not special-purpose ones, one general-purpose end-effectors.

Ms. EASTWOOD. Certainly since we had Steve on our committee, he did not claim they were readily available now. So it probably should have been one of the R&D topics. If I had my little marker, I would write that on there.

We tried to do the matrix. In our case, we felt the only two columns that we really spent any time on at all were discussing whether it was fully autonomous or just a telepresence. In our case, it would be primarily teleoperators.

The numbers here correspond to the numbers you have. On controlling of stationkeeping, we did not understand how we had much to do with stationkeeping. We were much more concerned with some sort of automated device that was within the station. We did not really understand how we should address that. So let me go on.

For troubleshooting and monitoring systems—let me get to my notes since I couldn't fit on much here. On troubleshooting and monitoring, we felt there would be very little truly autonomous troubleshooting. We felt although it was very likely sensors or something would detect the problem, since we were dealing with a robot manipulator itself, we would react in response to commands from somewhere else. This somewhere else wasn't clear; it could be coming from production system that says, "Go and check this part; we've detected an error." We did not think the robot itself had any preprograms there for troubleshooting.

We felt it was much more likely it would have a telepresence. There, again, we defined that as commands coming from some external system to run over and test this or to run over and verify that. So that is where we got those particular topics.

When you get to scheduled maintenance, on the other hand, we felt that was a place where you had a high capability of having it be pretty autonomous. We felt since they were scheduled and planned, you could have prepared a lot of commands in advance. It would be somewhere local that we would not have to have a whole lot of interaction with an external system. That is not to say we wouldn't use sensors to carry this out, but we would only be reacting in an autonomous mode.

We felt there it would be very good to have some sort of verification of occasional supervision might be required. On unscheduled maintenance, we felt it was just the opposite. By definition, we did not feel that from the manipulator's point of view, we could do anything autonomously and certainly in that case, we would be responding to commands from some external sensor.

No. 5 was material handling and transfer within the station. Again, we felt that it was very feasible to expect that to be pretty local if it is a planned task, and we feel a lot of the material handling will be planned, that it is in association with some of these other topics, it is in association with planned maintenance, it is in association with assembly, it is in association with production, and we felt it was very likely that would be autonomous, but unplanned again we assumed somebody else would have to tell us what to do.

For sensing and communicating, as I say, we found that would be one of the biggest R&D projects for us and that would be to react autonomously in response to sensor input. We are not sure that is what the matrix really meant when it said sensing, but it is what we felt applied to us, so we thought it would be good to bring that out that that is a big impact on us to react autonomously to those sensors.

For communicating, we had our own definition of what communicating meant. We felt that communications at our level, the joint commands would all be local, and we would not have to worry about bandwidths and things like that. We assumed any commands we got as far away as the ground or somewhere else would be of a higher level nature to start an already existing program. We did not anticipate receiving joint motion long distance.

For retrieval and docking, we did not feel we had autonomous participation in retrieval and docking. We did feel there might be some related task such as that where our external mobile robot would assist with the docking by going out and grabbing the other vehicle, perhaps. So that is where we got this qualified "yes" over here, but we did not feel for autonomous it had anything to do with it.

For construction task, we felt that that was very unlikely to be done in an autonomous mode ever. We were quite concerned about the number of unknowns in construction of these large structures from our standpoint, and we felt that here is where we would have the most trouble with our dynamics and kinematics is because we would be manipulating, first of all, we would have relatively flexible manipulator, followed by relatively flexible members out there, and we felt that would be a very substantial R&D effort.

From our standpoint, we felt there was very little difference from construction external to the station and satellite repair which is also external to the station. We felt they shared the same problems in terms of low-level control, that is why you see this showing up the same.

In production, we felt that, again, since those are planned tasks that you knew about prior to launch and that we felt we could provide all the appropriate tools or many of the appropriate tools in advance, we felt you had a very good chance of being able to do that in an autonomous mode and that for unexpected circumstances, we would be prepared to receive some sort of assistance. If we know something went wrong, we would call for help and one of those higher level systems would provide it for us.

I don't know how long I took. Are there any questions about the assumptions we made or our conclusions?

Mr. SHERIDAN. You didn't deal with the other two columns?

Ms. EASTWOOD. We did not. We felt periodic human visitation—we did not discuss this. I will give you my opinion. Periodic human visitation assumes you are autonomous all other times, and it would only be for verification, just to make sure things are still going right and permanent human presence, the manipulators, we claim they are multiple mode, that the astronaut could use them at his discretion but doesn't impact the control system.

The control system has to be able to do it whether it is a control pushing the button or automatic.

Mr. JACOBSON. The answer to that question is we——

Mr. SHERIDAN. You felt it could be either one of those first two columns.

Mr. BRADY. You outlined three research areas. Did you have any sense of the amount of research effort which is required to get from here, in those three areas?

Ms. EASTWOOD. We could not come to a good number.

Mr. JACOBSON. If you are talking about building a machine, if you are talking about issues like dexterity under autonomous control, it gets to be years.

Ms. EASTWOOD. It is a complete spectrum of how flexible, how dextrous.

Mr. BRADY. I wonder if you made an estimate——

Ms. EASTWOOD. We did not come up with a number.

Mr. SHERIDAN. Good. Thank you very much. Let's go on to the next one.

Who is ready? Marc Raibert.

Ms. BAJCSY. I have to leave at 3:30.

SENSING

Mr. RAIBERT. This will take 5 minutes. I was in the sensing group, and I thought we would start off by putting some caveats on what we think about the problem. I guess the first one is if the environment is very different from what is expected, and by that, we mean something has been penetrated by an outside object in a crash or something has exploded or anything like that, I think as far as the fully automated case goes, you can just forget about it.

Mr. RUOFF. In the foreseeable future.

Mr. RAIBERT. If you are talking about doing something this century, you can forget about it. The other one is there is a great deal to be gained in automating things if you don't go all the way. If you look to engineering solutions, that is where the meat and progress should be made, and you shouldn't go through the fully general glamorous solutions that some people think of in terms of robotics.

The last group took that approach, and said we will start from what we know and what already works and forward it. We were coming in from the other end; what can we do in the fully autonomous column and work our way back a little bit.

Even in the fully autonomous column, you don't want to go to the whole solution for some of the things. I think those first two apply to probably the whole list of problems, not just sensing, although we would think in terms of sensing. In terms of sensing, No. 3 says local processing for reduced bandwidth. That is something we think is an important concept that should be involved in that. Just in defense myself, even though I worked on that, Mike actually wanted me to put that up on the viewgraph.

The other thing is in trying to deal with the matrix, we were really unhappy with those four columns as listed. We tried to go back and refine what Mike said in his first comment this morning; there is sort of more than one dimension to this. The one that is probably trying to be represented there is how independent is whatever equipment, whatever computers and machines are on board, how independent are they going to be from human interaction. Sort of a separate issue is, how proximal are humans and proximal both in the temporal sense; that is, how often do they interact in the system, also in the spacial sense, can the humans use their hands, eyes, or other sorts of sensors in interacting with the thing or are we working through other equipment?

So, in response to that last thing, we changed the headings on the top to "Fully Autonomous," "Partial Autonomous," and "Low Autonomy." Low Autonomy means more like the normal kind of aid you expect to provide the astronaut even if the machines are doing most of the work.

The numbers at the left are how hard these things are to go to fully autonomous state where four is very hard, requires major research efforts in addition to all sorts of engineering things, and one is it feels like it is in the bag. We don't have to worry too much if we just proceed and could be done at the earliest thing. Let me go down the list.

What we addressed in control is the idea you have a station with—and we couldn't agree with the number—something between 5,000 and 100,000 sensors of various kinds. The issue is, how do you use that information from that kind of constellation of sensors to figure out what is going on, what is going wrong, whether the sensors are really telling you accurate things or not and maybe inferring what to do about a problem if there is one. We thought that was hard. It requires research, but not really as hard as the hardest thing. Troubleshooting, two cases. Troubleshooting could mean which thing broke and then indicating, somehow, which thing broke. That is a relatively easy case.

On the other hand, it could mean figuring out extent of damage after the problem and that is in the category that is very hard or perhaps undoable in the immediate range.

Scheduled maintenance should be the easiest thing. The idea some thoughts have gone into how this is going to be done in advance and parts to the system can be designed, automated part of the system can be designed in order to do this. Unscheduled maintenance is just like troubleshooting in the sense it could range anywhere from doing the thing that was going to be scheduled maintenance anyway but doing it at some other time or could range all the way to trying to repair unexpected damage. I would add, as far as sensing goes, not only does it involve determining what went wrong and possibly what to do about it, but also involves the thing Peggy was talking about before, using sensory information to guide the actions and devices that are doing the repair. That is very hard.

Material handling, again, there is a range of things. If everything is planned and worked out in advance, it can be easy and probably gets harder under some circumstances. We had a little trouble formulating exactly what the conditions would be and the range of situations under which you wanted to do it, so we gave it intermediate difficulty rating.

Sensing—you can't see it, but written in there is fusion and geometry. These are just two particular parts of the sensing problem, fusion being one of making a variety of sensors work together and there is a fair amount of work that still needs to be done before that can be a useful thing, in a context like this.

Geometry has to do with modeling and representing the situation that the sensors are reporting on or maybe figuring out the geometry of the situation the sensors are reporting on.

Retrieval, we thought, should be in the easiest category. We are not saying it is absolutely easy, but given where we are now, that should be one of the simpler things to do.

Assembly, there was quite a bit of dissent among the three of us in the group as to how hard this was or how easy it should be. We were thinking in terms of construction, sort of the model in my mind was seeing divers in the Marshall tank putting together large beams. Obviously, a whole range of things. Presumably, a lot of it would be worked out in advance.

On the other hand, the fact it could be a large-scale operation where there are free-flying devices moving around at various ends of the things, that sort of complicates some of the problems.

Satellite repair, there is an arrow on there pointing up to the scheduled maintenance, unscheduled maintenance, and retrieval. We feel that shouldn't be a separate thing, but it is sort of the same level depending on what you are trying to do.

Production, well, I guess we really didn't know what that means.

On the right-hand column, we started to try and do a range of things with that. Basically, one goal was to say, OK, how hard is it just for a human to do these various things, assuming little or no aid. The asterisk there for unscheduled maintenance, again, represented a little bit of dissent.

On the one hand, you can imagine a human with proper equipment, with proper education, and essentially the proper facilities could repair virtually anything that could be repaired. On the other hand, the actual situation under circumstances of being in a station or a shuttle or something is they usually don't have the appropriate things. There is a certain research that could go into designing the facilities and planning things to maximize how much repair could be done on the part of the automated astronaut. That is what we were trying to represent.

Carl, do you have anything to add to that?

Mr. Ruoff. I sort of think what the astronaut could do with hand tools, it is pretty much in the bag. It is kind of a philosophical difference, but you can make what you want out of it.

Mr. RAIBERT. Mike.

Mr. BRADY. One other thing, particularly regarding 1, 2, and 4 and why we felt they were hard. What we came to agree on was, in fact, a generic problem; in fact, the incorporation of multiple-sensors from different subsystems, complex operating system in an expert system which is capable of quality of reasoning, basically understanding a system state, quality of reasoning about the behavior of that complex system.

There are certain tactical steps taken along the way, such as simplifying interpretation of sensors, dividing a complex system into different subsystems—electrical, hydraulic, air conditioning, so forth—limiting the number of sensor types.

The reason this is a tough problem is that expert systems, despite their great popularity right now, have been almost entirely cognitive. There has, in fact, been very little work on interaction with the real world, and there are major problems in bringing more or less reliable sensor data into expert systems—according to current thinking about expert systems. In fact, we were going to argue, in fact, the need to make this focus of expert systems research dealing with real signals, there is need for at that all research, the need of several million dollars per year. That is why those were scored as particularly heavy.

Mr. RAIBERT. We made an effort to follow my earlier suggestion to put the ratings on how much work. It turned out to be very hard. We came up with numbers like 500 man-years, which was actually only a 3 problem, a problem we rated as 3.

In absolute sense, that is not that out of whack.

Mr. SHERIDAN. I think your scale is fine. Incidentally, you might mark which end is 4 and which end is 1.

Mr. BRADY. It is an exercise for the reader.

Mr. RAIBERT. Any questions about this?

Mr. SHERIDAN. Good.

Ruzena.

RELATIONSHIP OF SPACE STATION TO KNOWLEDGE REPRESENTATION

Ms. BAJCSY. I am reporting on a consensus. What we have focused on is only how does all this space station relate to the knowledge representation. Some of the things, of course, are repetition to some of you. This is kind of a list of research issues that we feel are important to knowledge representation. Knowledge about sensors, optics, signal, so forth, which is quite well understood, and I don't think that needs really much more research.

Representation about actuators, geometry, kinematics, dynamics—that is so-so understood. We didn't exactly agree how many more years we need on that. These things are, perhaps, better understood than many others, in terms of how you represent them, how you model sensors and actuators.

Now comes the objective stuff. Rigid objects we know relatively how to represent although we recognize R&D is needed in representing tolerance and error, but otherwise, the geometry of it is relatively understood.

Mr. ALBUS. Also, things like surface finish.

Ms. BAJCSY. Surface finish, yes. Reflectance is usually covered under some coefficient. So far, I don't see really a very fruitful way of going about it, but perhaps we can discuss it.

The jointed objects are less modeled although there are some simulations in human body joints. Of course, we really are very much in the beginning of understanding of flexible objects such as very flexible-like rods, and so forth.

So that part is poorly modeled and poorly understood. Furthermore, we haven't done very much in modeling distortions due to physical, thermal, elastic, aging, and other influences. In other words, a good physics model in a broad sense of physics is absolutely critical and R&D is needed.

We haven't touched anything on liquid and gases. Let's suppose we, by some magic, we would have models of these objects, then we need modeling of actions and this notion that there is a continuum of strategic planning to tactical planning is a notion that I learned from Michael Arbib. What is meant by strategic planning is very high level, global. An example scenario: I'm hungry, so I want to go to a dining room. Then the more tactical planning: Once I am starting to do it, the interaction with the sensory information and the actuators, is this more low-level tactical planning.

In any case, we all agree, and I suppose we are not the only ones, as I heard from others, that integration of perception and action which, again, Mike Brady coined this sort of——

Mr. BRADY. Slogan.

Ms. BAJCSY. Yes, it is R&D and we very much believe this is the way to go, and we also feel that vision and touch is a kind of generic problem. We believe that whatever we learn from integrating of these two sensors, that this will be relatively easily expandable to other sensors.

Now, again, as good engineers, that needs to be proven, but we have good reasons to believe that.

Of course, there is a need for R&D of new ways of knowledge representation, acquisition, and representation. And learning. Namely, once we have the knowledge data base and we are having these active sensors that extract information and interact with the knowledge base, it is just a very natural way that one needs to update this knowledge base, which is impinging on a problem of learning.

Hence, in conclusion, we feel that the country will get high return if support is provided in active use of sensory data in tactical meaning, that is the low-level planning and control of spacial representation and reasoning.

We believe that this is really where good resources will make a big difference. We have these pieces, the knowledge representation, tactile, sensory information, and we need to put it together, and we feel this will bring a great return.

I don't have more transparencies, but we did discuss, again, this knowledge representation, how it relates to this matrix, and we didn't discuss anything else but the fully autonomous situation, and we have only three things to report on that.

We came to the conclusion that the unscheduled maintenance is a kind of a generic problem that, as far as knowledge representation, includes assembly, satellite repair, production, et cetera, and we feel that as far as knowledge representation, that is the area which requires the much longer planning; we estimate 10 years.

In terms of shorter returns, handling 3 to 6 years and in troubleshooting or monitoring systems, less than 5 years. Thank you.

Mr. BROOKS. We said something about scheduling——

Ms. BAJCSY. Scheduling maintenance we said for solid objects we understand the situation—excuse me, Rodney is right. We said they fall into this category, that as far as scheduling maintenance—if you deal with a rigid object, we know how to handle it, but anything beyond that falls into this category.

Mr. BROOKS. Such as wires——

Ms. BAJCSY. It requires research and the estimated wire handling, for instance, about 3 years, correct, according to my memory.

Mr. SHERIDAN. I have a very general problem. I think when AI people talk about modeling and knowledge representation, they think of production systems and list programs and the like.

Ms. BAJCSY. No, we don't think that way.

Mr. SHERIDAN. Let me mention my concern, and I would like your response. Some of the areas you mentioned where modeling was difficult, such as thermal fluid systems and distortions in mechanical elements have been the subject of what some people would call modeling for at least a hundred years, thermal dynamics and applied mechanics. How are you using the words differently?

Mr. BROOKS. I think the way it has been used perhaps is in terms of simulation, so you can simulate the effect but not if you want to work backward. We say what conditions do we want to be guaranteed, what does that mean we can't allow to happen; for example, that we should be careful we don't have half a beam in sunlight, half a beam not in sunlight, those sort of backward questions are the harder ones to answer.

Mr. SHERIDAN. I think that is very important for me. This is a point of confusion, I think, with engineers.

Ms. BAJCSY. Indeed. This issue came up, and we discussed that there are these two extremes: Causal model, the inferencing systems, and production systems and expert systems fall into that category, but they are only a small chunk of what we mean by representation schemas, and we would like to get on the record that expert systems are a very small part of a general problem of representation schemas.

There is the other extreme, what goes on under simulation and various solutions, either that are in closed form or in some numerical simulation would fall into that category.

Mr. BRADY. I really think it is important to emphasize Ruz's point. It is a simple issue that most mathematical modeling of the physical world has, in fact, been in terms of analytical formula, partial differential equations, what have you, and that is a very useful representation. We found out for various kinds of questions you might ask of a system—is it stable, will it terminate, how many modes does it have, so on, so forth.

What we have discovered in AI in the last 25, 30 years is that there are rather different ways of representing certain kinds of information. They enable you to answer different classes of questions. That becomes really important when you begin to deal with very, very complex systems where the conventional mathematical model of the system becomes very, very crude numerical simulations. You can, nevertheless, write down a set of explicit inferences by making the right kind of information explicit in symbolic ways.

The downside of it is, AI has developed a whole set of techniques for representing information in these symbolic ways but, by and large, they have not been applied to real world issues like liquids, solids, springs, everyday stuff we deal with. There is a real challenge there.

Ms. BAJCSY. Allow me to add, there is a similarity as in control, you have a continuous control and then you have a discrete control, including decisionmaking mechanisms. Similarly, in representation, you have some processes that are best modeled by continuous models and other processes, in particular, inferencing mechanisms, where you have to go into symbolic representation and inferencing systems.

Mr. ALBUS. There is also an important issue in robot control, vis-a-vis the modeling, and that is: What questions do you need to ask, or what questions do you need to answer in order to make particular decisions at a particular time?

There is an issue of how long it takes to compute that and what do you do with that answer after you have got it, in terms of either analyzing sensory data or making control decisions.

Mr. ARBIB. I think we were trying to say that we wanted to dispel the view that there is a magic thing called expert systems for which generic research will carry us a lot further. We think it has had a number of payoffs at an early stage. We are now getting to the stage where the crucial investment is in domain specific analysis. We have tried to lay out the places where research is required specific to the space station. There will be some incremental work in expert system support, but that is not where crucial payoff will come.

Ms. BAJCSY. We also believe in the symbiosis of the sensory information with symbolic information that there is something very fundamental, that you need this interface and going back and forth, and by doing it we will learn very much.

Mr. SHERIDAN. I think in this area, almost more than in any of the others, there is a real need to make sure some of these points are made in laymen's language or else there is going to be a great misunderstanding. There already is with regard to expert systems.

Mr. Nitzan. I have a general question. What did you find that was unique to the space station relative to Earth applications of modeling?

Ms. Bajcsy. The modeling of the physics, very clearly.

Mr. Raibert. 30,000 miles of isolation.

Mr. Arbib. Mr. Chairman, another issue is that a lot of this work, to be achieved in real time, will require special-purpose computer architectures, both highly parallel and distributed architectures. We are concerned that the current cycle of funding may take too long to allow turning algorithms into the hardware which will provide us with quick turnaround on things we already know how to do, to enable us to concentrate on the new problems. Thus, we think a new funding strategy may be required to recognize when it is time to take a group of algorithms and very quickly develop hardware for them so the researchers can have access to special-purpose machines so that new research can ride on top of this without the incredible time lines that serial simulation, for example, would require.

Mr. Sheridan. Let's go on.

Jim Albus, are you reporting?

Systems Interfaces

Mr. Albus. We, I think, like the other groups as well, had some problem with the degree of autonomy matrix and, in particular, since we were discussing systems interfaces, I took the liberty as chairman to introduce a chart which is actually in a paper which I distributed around, I think, to most places so that I think everyone probably has a copy. It is figure 2 in that paper.

This is really an expanded degree of autonomy chart. There is a task decomposition hierarchy and a number of levels in that hierarchy, if you are controlling the manipulator system at the very low level so you are driving the joint actuator system, you have a teleoperator in the master slave kind of a mode.

If you are driving the system with some sort of a trajectory of the end point in a convenient coordinate system, you have some sort of a resolve motion rate control, kind of controlling interface. If you are driving it at the level of specifying elementary moves, such as reach, grasp move, lift, push, pull, the kind of commands you are interfacing with it at some sort of symbolic level but at very, sort of primitive things, and various levels of tasks, fetch mode, fixture, so forth, and there may be, in fact, this level may be expanded depending upon the length and complexity of the task, if it is an assembly task, you may want to decompose that in more levels.

At some level here, there is an issue of making sure you have the tools and equipment gathered together at the right point in time so that the manipulator has the materials that it needs to do the job and that those are flowing smoothly through the process of whatever it is you are doing.

At a higher level, still, you need to worry about long-range acquisition of resources, allocation of resources, tools, and materials. This particular chart was made up for a machine shop in which the highest level would be where the parts are designed. I think that is probably not relevant to our discussion here.

As far as the issue of system interfaces are concerned, I think this chart has several other features to it that are useful paradiegm for thinking about the problem that there are levels for sensory processing that service these different task decomposition modules and present to them the kind of information that are required for making decisions at the different levels.

For example, if you have an end point of a trajectory, you may want to have a process here that discovers the XYZ position of edges or grip points on a part. At a higher level here, you may need to recognize the part and determine its relationship to other parts, and so forth.

Also, the notion that you have a data base or world model which contains an interface between the a priori knowledge you have about geometry and surface characteristics and physics, that you bring a priori to the task combined with updates from sensors which tell you how a particular part, even though you know what its characteristics are, exactly how it is oriented and how it may be distorted by certain physical parameters in the environment.

The control system for a spacecraft manipulator probably should have all of these levels, as I think Ruzena suggested, and that as the task becomes more or less uncertain or as uncertainties arise in the task, the human interface will move up and down this hierarchy so that if you come to a task where something has been dropped or something is broken, you are trying to fix something, you may interface here at a level which says, Put the camera at a certain position in orientation in space relative to the broken furnace, or whatever, and send me back a picture of that, and those kinds of things, whereas if the task is proceeding along very well, you can interface with it at a much higher level, just giving it the system plans at a very high level.

Naturally, a system like this, the loops are closed at the various levels and if you are interfacing at this level here, you have to interface about every 10 milliseconds. If you are interfacing here, you may be able to get away with 10 times a second. If you are interfacing here, the system should report back to you, I am finished with that reach or grasp about once per second. A simple task may take 10 seconds or half a minute or something and as you move on up, you may have plans which run for an extended period of time.

In deciding what kind of control algorithms go in these levels and what processing algorithms you have imbedded in these models, it is extremely important to understand what are the tasks.

It seems to me one of the first things that needs to be done from an engineering standpoint is to decide exactly what are the tasks that are going to go on in the space station, what do the astronauts do, not necessarily because we want to do it in exactly the same way that the astronauts do, but at least we ought to know what it is they are supposed to be doing so that functionally we can analyze the task and break it into a reasonable decomposition and assign the various algorithms to the various levels and, in fact, we need various levels of detail of the tasks.

In fact, probably should; in fact, I am sure there must exist time motion studies of what astronauts do with their hands and what kinds of tasks they do because probably the most difficult thing, of course, is programing for uncertainties in algorithms for getting around uncertainties and you can't even begin to do that unless you have some sort of a detailed understanding of what the task is supposed to be so you can understand how the possible error conditions might arise.

We worried about issues of how predictable is a space station environment. The feeling was that it is a manmade environment. Presumably, you know where most things are so that for many things, that can go into the data base, into the model, so that a little bit of sensing can orient the robot as to where it is relative to parts, and so forth.

But in any case, you need to move up and down the control hierarchy depending upon the current level of uncertainty.

I am not sure if this is a cheap shot or not, but, in any case, there was the issue of what degree of uncertainty is introduced into the space station by the fact you put people in there and they shake things, move things because of their need to scratch their head, and so forth, and what degree of uncertainty is caused by human mistakes and errors, and how many of the situations where we cite that human judgment was required to get us out of that fix, did human fallibility get us into the fix in the first place.

Certainly NASA any time there is a mission, manned or unmanned mission, for that matter, flown, there is a mission planning document which specifies in great detail what goes on virtually at every minute of the entire flight.

From the standpoint of high-level planning and interface to this control system architecture, we felt that it was very important to study those planning documents, analyze the kinds of things that are called for in those documents. At the very least figure out ways to make those plans machine readable and then figure out what algorithms need to be implemented to make them machine executable. Of course, with machine capacity with modern computer technology, I feel that probably is not a major consideration.

We really did not get very far in filling out the matrix as it was given other than to think how one might move up and down a control hierarchy such as this, depending on the various tasks that are being executed.

For example, controlling and stationkeeping, basically come high-level input task is to maintain the spacecraft or the station in a particular orientation with respect to the Earth or with respect to the distant stars, whatever, and then the control loops are closed through sensors to make that happen and, in fact, with large flexible structures, it is not clear that a human taking over control may not improve the situation, even if the system was in trouble. The kinds of tomorrow constants, so forth, might not be amenable to a human flying large flexible structure.

For troubleshooting and monitoring systems, you would have to move down in the control system, interact at some low level where you are actually flying the ends of the manipulator to particular positions to look at certain things, camera systems or sensors to touch certain things or look at certain things, and so those kind of unstructured tasks you would move down to, perhaps, the XYZ trajectory or maybe the elemental move level where you say: Go to a certain position and make a certain measurement and tell me what the result of that measurement was and I will tell you what the next elemental move is.

On the other hand, if you have scheduled maintenance, it is entirely conceivable to have even a high-level schedule that tells you what tools you need for that maintenance, what materials, and so forth, and those are drawn out of material stock and made up into kits and then the system goes through a canned sequence which exists in these various modules so as to accomplish the scheduled maintenance without any further interaction. An hour later it comes back and says, "I finished. What do you want me to do next?"

Emergency or unscheduled maintenance, again, requires one to move well down into the system and take very close control over the manipulator and introduce human judgment on a very short time period.

Material handling and transfer within the station, in the case if you are handling materials or just drawing material out of drawers and putting it in grinders or furnaces, whatever, that could be a high-level task. If you are doing vein graphs on a frog which is on the operating table, you would probably move right down off this chart into the astronaut himself or the surgeon astronaut who is flying with the mission.

Sensing and communicating, again, the communication problem is simplified. The higher up you go, you merely need to dump in filed of plans at fairly infrequent intervals. If it is down here at the low levels, you need higher bandwidth because you not only need high bandwidth to close the loop, you need high bandwidth to get all the sensory information back to the human operator to analyze it.

Retrieval and docking, the kinds of activities there sounds, from what Roger was telling us, that that is pretty much an automated thing and should be able to be handled at a fairly high level as to just say when and where you want to do the docking.

For construction, I think you would probably jump all over this chart. For certain activities, you want to be controlling very closely. For other things, could you go up to a fairly high-level task to help move to the next position, draw out the next piece of stock, and get in position for doing the next task and then jump down to a lower level where you actually do detailed analysis and control.

Satellite repair, as everyone else has said, it is sort of in the area of troubleshooting.

Production, we had a fairly extended discussion on production. Where the process is known in advance, you probably can do it now, as long as there are no uncertainties involved. If you have fairly straightforward, simple corrective actions, that probably could easily make a 1990 launch date.

For complex interpretation and complex corrective actions of uncertain or experimental procedures in production, then you probably need an extended time period before we understand sufficiently the process and how to write the corrective procedures to make that autonomous, so these kinds of things would have to be done in the more teleoperator mode.

I think that is about as far as we got.

Mr. SHERIDAN. Any questions on Jim's report?

[No response.]

Mr. SHERIDAN. I guess you made that all very clear.

Mr. BERGER. Let me just ask a question. I thought I understood what you said up to the last two words of your last sentence. The distinction between the activities that you feel you could perform in the 1990's and those in the year 2000 was the distinction you were making, one, of whether it was completely autonomous because you mentioned in the 200 paradigm that could be done with teleoperators?

Mr. ALBUS. No, I am suggesting that in the 2000 year timeframe that we would have sufficient planning and interpretive capabilities. In a system like this, you do not have only preprogramed routines. Instead, you have routines that hypothesize an action, use a model to predict the results of that action, and use the processing system to evaluate those results. This produces a search over the space of possible actions. This is what we mean by planning. The system automatically searches for the best way of proceeding. Planning allows a control system to perform well in unexpected situations that you don't have stored programs for.

I think that in the timeframe of 1990, or, perhaps, 2000, it would be possible to have complex interpretive procedures in the sensory processing system, and sufficient planning and problem-solving capabilities in the control system that you can do planning and problem solving in real time. This will make it possible to do these kinds of production——

Mr. BERGER. In an autonomous mode.

Mr. ISLER. That came into play primarily when we were debating to what extent would you be able to get away with bringing completely raw materials into the station and then coming out with finished products. So I think the more you start with the basic raw materials and, therefore, have to get into making your plates and your basic materials from which you work, that is where we tend to get into the more "arty" interpretations and where we need specialists into plants to make the system work. It is in that sort of vein.

Mr. SHERIDAN. Let's go on with Roger Schapell's report, which is the last one. Make sure either Phil or I get these notes and overhead transparencies before you leave.

PROGRAMMING HUMAN INTERFACES

Mr. SCHAPELL. We had a lot of discussion and didn't get too much down on paper. I think on second look, we don't totally agree with this. Nevertheless, we were concerned with the programing human interfaces group and tried to generalize a bit.

The fully autonomous system we like with as natural an interface as possible from the ground. The human, in a loop, the telepresence system, again, assumed from the ground, we would also like to keep that interface relatively simple. The periodic human visitation, I think the key there is the invited intervention. You have a planner on board that tells you when you have a problem and you react to that as required. Then, of course, the last one being the permanent human presence in space. What I thought would be better is if I were to discuss these interfaces just briefly and show you about six photographs where we are addressing or have been addressing these problems.

Earlier when I talked about the simulator where we trained the astronauts, that is what I was talking about. That is a 60-degree free simulator and see a portion of the Shuttle on the wall. I might add that it takes a bit of training for the unindoctrinated individual. That is to say, a fighter pilot picks up fast but the rest of us tend to fly into the wall. The system does react to a simulated zero G environment, although if you do go upside down, money does fall out of your pockets. [Laughter.]

Mr. RAIBERT. Does that work with your sponsors, too?

Mr. SCHAPELL. Yes. [Laughter.]

That recently happened to Governor Lamm in Colorado. [Laughter.]

What I want to do is go through a few of the NASA arms. This is the SMA which was developed and is currently being used to evaluate various control modes. It is a 14-foot arm. What you see here is for an experiment in the module changeout.

The reason I am showing this, we will soon get to the interfaces that are involved and, in fact, there is a rather significant activity in trying to come up with a so-called reconfigurable ground control station, or control station, not necessarily on the ground.

Earlier I mentioned the IOSS. Right now this is resident down at Marshall. This is a front-end servicer with a plain arm and a simulator satellite here. This is a preprogramed system; that is to say, it cannot be teleoperated in its current configuration. In its current configuration, I certainly wouldn't advocate flying it because it does not have, in this mode, the sensory perception to keep it from destroying the satellite that it is going to interact with. This arm is being used at Marshall right now, the PFMA, for some laboratory experiments. It was designed to be flown with a few modifications, including removing the counterbalances.

You will notice in all of these, there are counterbalances for the 1G environment. With a few modifications this arm could fly. It is about 8 feet. It is extendable. It was designed for operation on the Shuttle. What I am trying to tell you here, those of you who have asked me a number of questions about the ongoing activity, there have been a number of systems developed and are undergoing evaluation for various control modes and so forth.

The interaction with these systems, the SMA, is driven by a single 60-degree free arm. What we are currently doing is building two more of those for controlling two arms. Of course, things get rather complicated. You are trying to monitor other parameters; you have a visual presentation and, in fact, we are once again going to the mono versus stereo versus the helmet-mounted type system. But when you go to the helmet system, then you have another problem, a display of other parameters and also the exoskeleton. Some of you are familiar with the work that NASA did on their dual-arm system with an exoskeleton. It certainly simplifies the interface to some degree.

This one some of you have seen before also. This is the ROSS. What you are seeing here is a propulsion system. There are several configurations of that. This is a front-end servicer with the two arms which are based on the PFMA design. The extending docking probe—and, of course, this is a problem with satellites that have not been designed to be serviced. You have to be able to grab hold of them and it has to be in reasonable proximity to where you want to work on the vehicle.

We have another internal design that has two more arms and allows you to crawl around the vehicle. There is a whole unique set of problems associated with that. It is rotatable about the center axis. These are modules and it might change out from the spacecraft to be serviced. When you consider that type of system and you look at the ground control station, whether it be on board the space station, shuttle, or on the ground, you have got a lot of things to think about. No. 1, you have got to maneuver the vehicle if it is a free flier. Some of you hit on the propulsion of this servicer, whether it be inside the space station where it could be on rails or if it is outside the vehicle or trying to interact with a satellite and say you are trying to work two arms and control the vehicle, it is a difficult problem. One man can't do it very well, but it is a complex human interface.

Another program which goes a step further and talks about the fully autonomous system is a thing called ITA.

Maybe Bill can give you a few words on this in a minute.

What I want to show you here is this is a current laboratory setup. What you are seeing is, there are two Cincinnati millitron 727 arms and 10-foot F-15 bulkhead in the middle. What we are asking the system to do is to inspect it. It has an intelligent plan, high-resolution scanner, and this is a presentation and we talk about these autonomous or automated systems but very few of us think of the components that go into it.

I have heard very little about computer architectures, but this is basically what this system consists of—the sensory system, the list machines, high-speed processor. This is intended to be the circular pipeline leading the processor, really called the gap system now. Of course, about 28 microprocessors.

Bill, do you want to say a few words on this?

Mr. ISLER. Yes, if you have time.

Mr. SHERIDAN. Can you make it quick, Bill?

Mr. ISLER. Yes.

Mr. SHERIDAN. I want to finish up and get on.

Mr. SCHAPELL. The reason I bring this up, I feel it is important. Not everyone is aware of it, but it is a step toward the autonomous, or the automated, robotics system, which could be used for inspection and, ultimately, hopefully, assembly in space.

Mr. ISLER. There are two really ambitious demonstrators in robotics. The one that Roger was talking about is commonly called the coordinated dual-arm system. It will do the F-15 bulkhead inspection. The other is programable assembly robot being done by the Honeywell team. In both these cases, there are several issues we talked about here the people at NASA and the rest of you who will be studying this issue that you should be aware of. We are, in these two cases, going a long way toward integrated sensory control of devices in real time. In both cases, it is funded by us and the Air Force Materials Lab, and each team represents industrial and university involvement. The areas of research, as Roger mentioned, are the high-speed processors, the tactical strategic planners, and, in the case of the Martin robot, the end-effectors are interchangeable and we are not pursuing in that case very much dexterity. Whereas, on the other hand, in this, Honeywell project which will assemble a microswitch that has rubber pieces, springs, rings, gaskets, the components will be assembled and disassembly will be verified.

I think in both cases, we have robots that are very much in the industrial-type setting, but I think the kind of things we learn here can be transferred both to some of the NASA problems and also to some of the DOD problems of maintenance, logistics, and weapons.

This is why we are involved. Any of you who want to know more about this, I can talk to you about it later.

Another program that we have at DARPA is autonomous vehicle program which is one of the offshoots of the strategic computing program shown there on the right-hand side of the viewgraph. The four-legged device shown there schematically would be a dynamic balance of a four-legged machine and Marc Raibert is doing research in that area.

The autonomous ground vehicle program, the one that is part of the strategic computing program, we are not committed to the legged vehicle, but we will start on-road navigation, road following, and toward the end of the program out 5-, 6-year timeframe, we will try to do off-road navigation out to several tens of kilometers and with route planning, obstacle awardance.

Once the device gets there, the kind of application we are thinking of mostly is one of reconnaisance and surveillance.

At this time, this will be done in a telepresence kind of a mode. We are talking autonomy and navigation from point A to point B, but we are also planning for the applications once we get there. I will just stop there.

Mr. SCHAPELL. One last thing. An area we keep bringing up is the failure isolation. In one approach, we are working it to get to the failure work around and providing complete transability. For the NASA application, we are concerned with one specific subsystem and also the resource management of that system.

EARTH AND TERRESTRIAL APPLICATIONS

Mr. SHERIDAN. Any questions to Roger or Bill?

I say again, make sure we get your notes and so on for each of these groups.

It is now about 3:50. Our hope was that we could spend some time talking about the—what was your phrase, Phil, the Earth, terrestrial application on some of these things.

Mr. CHANDLER. Yes.

Mr. SHERIDAN. Do you want to say a word about concern on OTA's part?

Mr. CHANDLER. If Wally wants to, that will be fine. It would be, of course, of interest to know in what respects pushing the technologies in any of these different ways we have looked at today could be applied to, if not immediately, then without too many intermediate steps to research problems on Earth that are more or less well defined.

In other words, what Wally and I had come to agree on in our conversations was the space station really represents an opportunity—it could be a focal point of research in automation—which doesn't come along very often, of course, and we should think of how to use this opportunity for Earth-based applications as well as doing what is obviously needed up in space.

Mr. SHERIDAN. Other than, please send money, which I think we would all happily participate in, how can we say more about that?

Mr. CHANDLER. Let me put the question this way: Are there some outstanding problems in the research any of you are doing currently which you can foresee being benefited by the kinds of things NASA is thinking about?

Mr. SCHAPELL. I think that is almost across the board.

Ms. EASTWOOD. All of these things will help us. There are certainly generic problems and any results that come about can be applied here, I would say. Somebody asked what is different about being in space when you look at that particular problem and, except for the physics, we couldn't give you any other answers.

So I would say there is a very high parallelism what we are doing here and what you want to have happen up there.

Mr. CHANDLER. Nancy?

Ms. NAISMITH. As I heard the discussion thus far, there is no particular research area that would benefit any more than other than work in space and there are no unique opportunities by space to further the work of these technologies.

Mr. SHERIDAN. I don't know if that is quite true. I think there are some problems that have to do with demonstrating coordinated, integrated control. The mere fact of putting some of these pieces together is important. You can put pieces together on the ground, but there is something about the space environment that is convincing.

Mr. ISLER. I would turn it around. I guess one reason why I wanted to say a word or two about what we were doing, certainly as they go into the 2-year study to plan the specifics of tasks they want to make sure they are aware of where we all are now and what we are doing so that NASA doesn't use this money and start back at a point that is too primitive. In other words, reinvest things. But the other thing, for example, at Stanford there is work going on funded by us and others of control of flexible arms. Probably if you go to some of the space applications, some of that work will find, say, real applications there, perhaps, quicker and with necessity quicker than they will for some applications here on Earth.

It may be the other way around. I think maybe there are things we are doing that will find applications and help the NASA problem more so than the other way around. Basically, as I understand the NASA program, the R&D part is just getting started. I think NASA is in a position to see what they can understand from R&D.

Mr. BRADY. I wanted to follow up on the point Bill was making. It seems to me what we heard ever since lunch has been a whole string of generic problems, ranging from dextrous hands to flexible manipulators to integration of real world sensing into expert systems, et cetera. We probably have seen 10 generic problems listed this afternoon. In fact, on each of these problems, there is work going on right now, much of it, in fact, with private foundation funding.

There is a small research base already in existence which you ought to know about. On the other hand, I just merely want at some point in the day to point out a major problem right now in realizing this kind of vast accelerated activities exactly the small research base. It is not like trying to take hold of 10,000 engineers and just get them to act in some coordinated way in order to do something, like put a satellite up, or some such thing. There really are some fundamental research problems and the number of researchers around the community is very small indeed. Even if you are extremely generous, it is a very small number—in the hundreds. Very small meaning like three. That is a real major problem and that means you can't just throw a huge amount of money at a research base because a lot of the groups are already extended to what they can do. There is a growth problem.

Mr. SHERIDAN. Jim and then Russ.

Mr. ALBUS. I think the biggest difference between robotics research for space and robotics research for industrial applications here on Earth are the cost drivers. On Earth, industrial research is, if you leave out the military for the moment, driven by the cost of labor in factories which runs anywhere from $5 to $25 an hour. If you are talking about robots in the space station, you have robots competing with astronaut labor that runs $10,000 to $100,000 an hour. This means that you can think about much more exotic technologies. You can push the state of the art much harder from the standpoint of what is possible, and can be less constrained by the requirement that sensors and controls must not cost more than a few thousand dollars.

For example, a robot in a space station with a $500,000 vision system on it, would probably be cost effective. To put a $500,000 vision system on a factory robot would be absurd.

So I think NASA is uniquely positioned here to support robotics research at the cutting edge of what is possible. It would not be constrained, as we are in the industrial research community, by what is feasible for commercial products.

Mr. SHERIDAN. Russ.

Mr. TAYLOR. I have a couple other things to say, but I would just like to interject one point. In dealing with industrial applications of robotics, you look at a lot of things other than labor costs—product quality improvements and integration with the factory system are often far more important than displaceable labor costs, especially because many of the things that we use robots for, such as the testing of computers, are just utterly impracticable to do with people.

I might add that I think a lot of those sorts of capabilities which the space station may develop will have immense application on Earth. An example of that is, if the use of telepresence for human supervisory control of remote manipulators, in which you have many robots working and then occasionally one of them calls a human to intervene, would have enormous applicability on Earth.

The point here is that in something like the space application, this may be the only practical way to do a job. If you can develop the basic technology in space, and you get people who know how that technology works, then the development and engineering of practical system on Earth will be possible. The economic advantage to our country of having that expertise, I think, is enormous.

One other spinoff that we have not focused on today at all is the on-ground automation associated with something like the space station. The design automation tools that would let you develop a space station quickly, and the production capabilities that would allow you to manufacture subsystems to order, would be extremely valuable. The capability to fly components within 2 years after you conceive of them, rather than 8 years, would have an immense influence in American industry in helping us compete with the rest of the world.

Mr. SHERIDAN. Let me render an opinion which I suppose hasn't quite been mentioned yet. It is my judgment from limited experience that both military and NASA projects in the past two decades have generally been—the thinking has been in terms of specific pieces of hardware to do specific jobs. When automation is applied, it is applied to do those specific jobs, as well it might.

The same would be true in industry. You design a gadget, a machine to drill holes or to stamp out certain kinds of parts or extrude certain things, you design it to do that job. We are talking here, however, about general capabilities which are very robust, where we can involve mixes of both people and computers and auxiliary mechanical devices. NASA has never been willing to commit to that kind of flexibility heretofore. This looks like an opportunity, in terms of Roger's infrastructure to change NASA's thinking on that.

One of the reasons why we have never spent much money on teleoperators is because they don't make much sense if you have a specific job to do. You don't design a general-purpose robot or teleoperator if you can do it much more cheaply with a specific machine. So I think in that sense of really understanding how people and automation can work together, this is a marvelous opportunity.

Ms. Eastwood. Following on what Mike was saying, there are not that many people in the field, certainly everyone quotes entering the space program in the first place, instantly quadrupled the number of engineering students or had some big impact. I would say the same thing is true with expert systems. As soon as oil companies decided they had a practical use of expert systems, presto, the number of people interested in that part of AI seems to have gotten very large or at least a lot more obvious.

If it does nothing but increase the awareness level of companies that up to this time either had never considered the topic or didn't think they could make money at it, or whatever, I think just the increase in awareness will have a lot of benefits throughout a lot of auxiliary companies in what we are doing here.

Mr. Brady. I am aware my remarks came out negative; I didn't mean it. I am glad you gave me the opportunity to expand. I think there is an opportunity and a danger. The opportunity is exactly the one you put your finger on; namely, if NASA declares it is delighted to receive billions to sponsor research in this area, then, by God, they will get those and burgeon interest all over the place. The danger is this stuff is getting oversold. There is an enormous amount of hype about AI and robotics right now. I think AI and robotics are solid. I really think there are some real contributions and real progress that have been made over the last 5 to 10 years in AI and robotics.

There have been some very incautious statements of late. I have tried several times today to put dampers on discussions, which is quite uncharacteristic of me, but it has been for exactly that reason.

Mr. Sheridan. My perception is the people really doing expert systems say, if you have a better way of doing it, by all means use that.

Mr. Brady. Professional ignorance.

Mr. Sheridan. That endears those people to me.

Mr. Brady. There are few notable exceptions, however.

Mr. Berger. If I might just comment on what Michael said here, this is an issue that has troubled us for some time and that is, you have a very, very different management problem if you deal with a program that is really being developed by a large number of small groups. That is one of the issues we have asked NASA to look at: What difference does it make in your management approach philosophy and timeframe. This is a lot different than asking someone to build a spacecraft.

Mr. TAYLOR. This is a comment along those lines. I can remember, as I am sure all of us can, numerous cases where there was an "in" subject. One of the in subjects when I was a grad student was automatic programing, and there was a lot of money coming from DARPA and there was a great rush of researchers to rename their research, whatever it involved, to be "automatic programing."

That isn't necessarily bad, but to what extent should a mission-oriented program such as building a space station be viewed as a source of funding for basic research and to what extent should it be viewed as a program to accomplish a particular mission? Obviously, you want to do both, and I have been stressing the benefit to society of educating your technical community by having them do mission-oriented work.

Mr. BERGER. I guess it depends on your definition of "mission," NASA's mission. If you look at the 1958 Space Act and the things they have been doing, the mission specified has a very heavy component of advancing scientific knowledge, technology, so forth, even some of their very applied programs, aviation programs, have some very fundamental science aspects that are being addressed that don't have direct applicability. I think it depends. I think one way you can resolve some of that is if you really look at the array of missions that you are proposing on the space station—and another reason why the space station is so appealing is that it has such a broad spectrum of applicability—you look at them and say: This is our mission set and now what can we do to facilitate that mission set, in the analysis of those functions, you will come up with some generic things you have to deal with.

I don't think it is incompatible. It is not like you have one single mission of changing this tray and now we have to develop the ideal manipulator to change that tray. I don't think that is the case. We have a broad enough spectrum of activities that you are bound to address some of these very basic issues in dealing with them.

Mr. SHERIDAN. Jim.

Mr. ALBUS. I would also like to comment on Mike's comment. It certainly is true there are a small number—and 300 is probably very generous—of doing basic research on these fundamental generic issues. But an awful lot of what is required to advance the state of the art in robotics is just good solid mechanical and electrical engineering. Certainly there are a lot of those kinds of people around.

Mr. SHERIDAN. Let me say amen to that.

Mr. ALBUS. If they are put to work for the right people in the right laboratories.

Mr. SHERIDAN. Mike is used to this. You would expect those people to be coming into AI, but every second, every mechanical engineering student that comes around and writes a thesis these days wants to do robotics. I say, "Well, what does that mean? Does it mean mechanics, control, electronics, and all those things?" "No, no, robotics." Your point is well taken.

Mr. JACOBSON. Sort of a parallel in the area of prosthetics. For years we were involved in developing artificial arms. We would go to various agencies and say, "We would like to work on a control system and a machine, a device." They say, "Go to the Moon; that is no problem." We developed kidneys and finally developed a heart and along the way we found out the technology was not there and did a lot of fooling around and finally made a device in spite of the system.

Along the way, we actually found actuators are not what they should be, not that we can't wire motors properly, but that the physics are wrong in the actuators.

As a result of those kinds of efforts, we have projects going with DARPA and other people to develop new kinds of actuators based on other principles.

I know there has been a lot of arms made, but I think we should think a lot about actuators, sensors, and this whole array of stuff that usually gets neglected.

I have to say another thing. I heard a wonderful quote that ties into what you said about students—at least I think it is wonderful. A little girl wrote this quote and she was talking about airplanes. She said, "Robotics won't belike it should be until it was like when we didn't have it and appreciate what it could do for us." I love that. I think that really sums up what everybody thinks—no, I want to do robotics. They want to do things like——

Mr. SHERIDAN. R2D2.

Mr. JACOBSON. That may in the end be the big driver, the showstopper, the thing that determines what gets funded and what doesn't.

Mr. SHERIDAN. Let's move the conversation now toward what we can conclude generally and give some testimony for our friends in Congress in a week or so. We have all this grist that you have given us in the form of comments and written reports. Is there some obvious concensus in all of this? Is it aparent to anyone?

Mr. JACOBSON. It seems like a lot of discussion has been revolving around how to physically interact with things out there. When we talk about parts that fit, so on, so on, but what it comes down to a lot of times is, how can I send something and interact with it?

Ms. NAISMITH. Would that be like integrated sensory control of devices in real time?

Mr. SHERIDAN. We are trying to understand what you mean.

Mr. JACOBSON. It seems like a lot of our discussions have been peoples, first of all, mistrust of automatic systems, although we all work on them and, guised in various ways, our fear that we can't interact with things physically out there.

Mr. SHERIDAN. You mean human interaction or physical interaction with other physical things?

Mr. JACOBSON. It seems like it is relatively easy to make a spacecraft that goes out and sends back pictures and doesn't have to physically do much, but the minute you go out repairing things or going around and changing the configuration——

Mr. SHERIDAN. Mechanically interacting.

Mr. JACOBSON. Yes.

Mr. BRADY. I guess I see everybody around here as being cautiously upbeat about this kind of proposal. I think we are all essentially positive. We think it is something important and doable. We all have cautions, certain restrictions, caveats.

In the final analysis, I feel there is a concensus of cautious optimism.

Mr. TAYLOR. Toward what?

Mr. BRADY.We can actually build something useful, even if it isn't completely autonomous. It would have a kind of supervisory control, certainly a large amount of autonomy could do something that could meet the kind of specs that were laid out in these various reports that were handed out to us. I completely agree with Steve Jacobson, one of the things we kept coming back to time, time, and time again, is the need to model the real world and its imperfections and, in particular, the crucial nature of sensing since that is a key step on the way toward loosening up some of the predictability we see in industrial robots. That statement applies equally to the applications of artificial intelligence when you come into this kind of application. Namely, it has got to be really extended and made to deal not on the occasional cases published in a research paper; it has got to be extended to deal with all the vagaries of the real world and to support inferencing in terms of geometric models and what have you. There are certain generic problems. We have kind of identified them, but in the end, we are fairly cautiously optimistic we can build a relatively autonomous system interrupted by people to a certain extent.

Mr. SHERIDAN. Is that shared?

Ms. EASTWOOD. As we went through all the committee records, it went from very concrete, which was our committee, to very esoteric, which is the last committee. You talk about what we can do in the short term and what to expect in the long term. Certainly if you stuck with planned tasks, whether it be maintenance, production, or whatever, I would say in the short term, essentially every committee said they could handle the planned ones in a relatively short amount of time. The unplanned ones almost gave all of us a bunch of trouble. I don't know how that fits into their testimony, but I think it was a consistent result through all of our little reports.

Mr. RAIBERT. I guess I would propose some contrast with Mike's statement by saying we are all confident there can be some autonomy.

Ms. EASTWOOD. We had some yeas and a bunch of nays for autonomy.

Mr. BRADY. I said cautious.

Mr. TAYLOR. People are cautiously pessimistic, if it comes to believing you can have a partially autonomous system.

Mr. SHERIDAN. It seems to me there is an awful lot of public education here and I should think people in power in this company still believe something is automatic or it is not. I think there is a lot of educating to do to make people realize——

Mr. RAIBERT. As far as I know, there is nothing that is fully automatic anywhere.

Mr. SHERIDAN. There are things that come pretty close. There are clocks and there are Viking spacecraft that get pretty close. These are different from an Apollo spacecraft which people think is manually flown to the Moon or a Space Shuttle, which people think is manually flown.

Mr. HERMAN. Everyone mentioned the Apollo program. The Apollo landing was automatic. The system did not need a man to land on the Moon. Just like a 747 can take off from New York and land in Los Angeles without a man. But the one thing that is exceedingly difficult to simulate is an astronaut like Jack Schmitt who was able to get a distributed, selected sample of lunar material under the precise instruction of one of the best geochemists in this country. On the basis of the lunar material that he brought back, a profound analysis was done on the samples; the Soviets couldn't come close to this with the grab sample they brought back. That kind of simulation seems to me would be exceedingly difficult, in effect replacing with a machine that kind of trained geologist astronaut.

Mr. SHERIDAN. That is a very good calibration point, I think.

What can we say about unplanned things? Do you put up your hands, or do you march toward that with automation and artificial intelligence in some systematic way? For things that are unplanned, can you do some sensing in intelligence to cope with them at some point?

Ms. EASTWOOD. I think maybe what we are trying to do, things like group technology, where if you have done it for one part, you can with small changes apply it to similar problems or similar families of parts or similar conditions. I think that if we have successfully done the planned task, you then have this little repertoire of tasks that automation can do and then when you find the unscheduled task probably looks very much like one of the scheduled ones.

So I would hope that once we successfully have done the scheduled ones, it isn't that big an incremental development to let you do the unscheduled ones. I don't know if that is true, but I would like to claim it should be true.

Mr. ALBUS. I think it is true. Particularly if you have programed the primitives that allow you to decompose and plan tasks. Then arranging those primitives in new sequences, and attaching parameters and data variables to those primitives, should make on-line planning possible.

Mr. SHERIDAN. Rodney and then Michael.

Mr. BROOKS. I think it is false because I think the unplanned tasks, many of them, when something goes wrong—the planned tasks rely on their being little uncertainty in the world, and so you don't have to do that much sensing because you almost know everybody already. You only have to do a little bit of sensing. When something has gone wrong, you no longer almost know anything, so a little bit of sensing won't tell you what the state of the world is. You have to do much more sensing to find out the state of the world. I think there is a quantum jump between the two.

The unplanned tasks is an area of where a lot of AI robotics research is sort of dancing around the edges of—and I don't see that we have any clear idea how it is going to proceed in the next few years. Maybe it will take 1.3 Einsteins. We can't tell.

Mr. ARBIB. What I was going to say agrees with what Rodney is saying. You may not have enough onboard artificial intelligence, but you may be able to send enough information back to a human off-station to come up with the high-level commands which we have already built a system to accept. If an event is not only unscheduled but very surprising, I don't think there is any way that in this century we will get onboard intelligence to handle it.

Mr. TAYLOR. Part of the technical difficulty is that there is a contrast between using sensing to construct a model of the world and using sensing to match a model that already exists. And the one is much, much harder than the other. If your fuel tanks have exploded or you don't have all the measurements, something has happened that you don't have the information to update your model with, it is very hard. It does seem to me that perhaps there are a couple other guidelines that should be considered. Again, the design of the spacecraft and the design of the interfaces for information gathering and for automation probably ought to be anticipated as much as possible and built in from the very beginning and, in fact, ways of learning how to do that could be also immensely useful on earth.

Similarly, if you view automation as increasing the productivity of astronauts, the same sorts of things eventually could increase the productivity of people here on Earth.

Mr. BRADY. I agree with Peggy. The thing that kept on being a recurring thing, was the difference between planned and unplanned damage. There is no doubt in its fullest version it is a very hard problem. We would like to know if the thing is automatic or completely automatic. I don't think there is necessarily a complete demarcation between planned and unplanned either. It seems to me we can make certain simplifying assumptions. For example, we make simple assumptions, the hydraulics are completely independent of the electrics, say, and that simplifies our problem enormously. We may not know exactly the position or orientation of something like a satellite to be fixed is, but we might know it is within some bounded domain that we can go look at. It is not that we don't know where it is in space; we don't know where it is in the room. So it seems to me there are a whole bunch of milestones which take us from where we are now, which is epsilon beyond the state of the art in terms of dealing with very highly planned things, to the situation in which we are dealing with complete chaos. That is the nature of good engineering research to identify what those milestones are in a decade or so.

Mr. VAN ALLEN. At this point in the meeting we have a great need to digest our discussions into layman language in order to have any impact on public policy. I have been trying to do this during the past few minutes in a way that is largely free of technical jargon. Let me try my summary on you.

First point: I do not think that it is a matter of general knowledge or appreciation that there is already a very large amount of human interaction with and control of so-called automated spacecraft. Such control is done on a massive scale from ground stations on a daily basis. It also plays a vital role in the flight operation of manned spacecraft. This human interaction comprises monitoring, troubleshooting, diagnosis of malfunctions, and development of "work-arounds," as well as planned activities of the sort that I described last evening. Hence, there is already a large degree of telepresence in space activities.

Second point: It seems to me that further robotics in space has a great potential but it must be nurtured at a level far beyond its present level of support in order to have a growing importance during the next decade. I think that everyone here agrees on that. Robotics is a lively field of investigation and development but it has nothing like the push that is required to make it of growing significance in the space effort during the next few years.

Third point: In the context of a space station, it is reasonable to plan on a continuing interactive combination of men and machines with a progressively greater dependence on robotics as we learn how to do more things reliably by machines.

Fourth point: Most of us have expressed a considerable pessimism about the reality of a fully autonomous space station in the AI sense during this century; that is, spacecraft that can diagnose their own operations and take corrective actions, if necessary, in the resourceful, intelligent sense that can be expected from professional human operators.

Those are the four points that I have distilled out of our discussions. They may or may not be thoroughly satisfactory. They deserve further discussion. I do emphasize that our conclusions, whatever they may be, must be cast in some such form if we are to make any significant impact on national policy in the area of robotics.

Mr. SHERIDAN. Are there ways we can build into our space systems flexibility to have varying degrees of going toward full automation or backing away from it? It is a little different than what we have been talking about. That is to say, if you put something up there and it runs completely automatically, fine, don't rock the boat. But if it doesn't, then you can intervene and have a lot more human interaction.

Mr. VAN ALLEN. One of the things strongly impressed on me is the need for an incremental approach for this. I don't think we have grandiose solutions to anything.

Mr. SHERIDAN. I am concerned about being locked in at one level. Are there ways we can be robust with respect to the level of automation?

Ms. EASTWOOD. I think it is feasible. We put in our robots have to be able to run under both modes, automatic and semiautomatic, which I think is very possible. If you look at current industrial robots, you can do that now with them where you can just put in the program and run it or almost all of us now—one can be driven by some supervisory computer where we will accept one command at a time rather than a whole program.

I would think it would not be that difficult mechanically and, from a control system standpoint, to be able to switch through these. Do you accept a whole program or do you accept a single command. That kind of generality is not too bad.

Mr. ALBUS. I certainly agree there is a whole hierarchy of control levels, and I have tried to point out what our laboratory's approach is to how that might be done. It is important even in the simple case, where everything is just as it should be, that you don't have just the minimum complement of sensors that is required to do things when you know everything.

It seems to me you should have a large complement of sensors which are continually verifying and updating and refining whatever information that you have in your model so that when uncertain conditions arise, those sensors can be brought into play even though you could have gotten away without them in a more simple, straightforward environment. Robots with many sensors which measure the same physical phenomenon is an interesting research topic in itself. How do you integrate the information together and accumulate information from all of them.

Also, if the control system is properly designed, the human supervisor can drop down to a lower level of control.

FINAL OBSERVATIONS

Mr. SHERIDAN. We promised ourselves we would try to finish by 4:30. It is approaching that point.

Are there any final observations?

Michael, you had your hand up and didn't get a chance to say anything. Do you have any final words of wisdom?

If not, does anybody have any final thoughts they want to render? If, by the way, any of you has some comments that are at odds with your group report as given, we are welcome to collect anything and everything. At least I hope Phil is. He is going to take all this stuff and make some sense out of it.

Nancy?

Ms. NAISMITH. I often find things become much clearer to me when I am on the airplane almost home. If any of you are subject to that same delay, if you would like to call tomorrow, the next couple days while we are trying to think this through and make sense out of it, if you would want to write to us that would be wonderful; that would be time consuming. If you want to call and chat and you say I think something——

Mr. SHERIDAN. You will pay for a collect call?

Mr. BERGER. I would just like to thank everybody for their time, patience, and participation in what probably is an impossible task under a lot of constraints. But it has been very helpful to me and I will convey that to the members of our subcommittee; the kind of general feelings and the specific comments that have been made. I look forward to the 29th, which is a week from Thursday, when we will have someone from this group, possibly Phil or Tom or one of the Toms, come testify and try to give us a little better feel, give the members of the committee a better feel for what went on.

Once again, thank you very much.

Mr. Akin. Can I ask what will come out of this? Will there be overall papers drawn from the group?

Mr. Sheridan. There will be a report.

Mr. Akin. Will that be distributed to us?

Mr. Chandler. Yes; we will send out a draft to you and you have 10 days or so to look it over. You also have a chance to look over the transcript and fix up your remarks.

Mr. Berger. The report will appear in the congressional hearing record of our subcommittee.

Mr. Akin. Then we will get a copy of whatever testimony there is?

Mr. Berger. Yes.

CONCLUSION OF WORKSHOP

Mr. Sheridan. Thank you all.

[Whereupon, at 4:37 p.m. Monday, March 19, the workshop was adjourned.]

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1985

THURSDAY, APRIL 12, 1984

U.S. SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS,
Washington, D.C.

The subcommittee met at 10 a.m. in room SD–124, Dirksen Senate Office Building, Hon. Jake Garn (chairman) presiding.

Present: Senators Garn and Abdnor.

FEDERAL EMERGENCY MANAGEMENT AGENCY

STATEMENT OF LOUIS O. GUIFFRIDA, DIRECTOR

ACCOMPANIED BY:

JAMES J. RITA, BUDGET OFFICER
GERALD S. MARTIN, EXECUTIVE ADMINISTRATOR
JEFFREY S. BRAGG, ADMINISTRATOR, FEDERAL INSURANCE ADMINISTRATION
FRED J. VILLELLA, EXECUTIVE DEPUTY DIRECTOR AND ASSOCIATE DIRECTOR FOR TRAINING AND FIRE PROGRAMS
DAVE McLOUGHLIN, DEPUTY ASSOCIATE DIRECTOR FOR STATE AND LOCAL PROGRAMS AND SUPPORT
BERNARD A. MAGUIRE, ASSOCIATE DIRECTOR FOR NATIONAL PREPAREDNESS PROGRAMS
WILLIAM F. WILLIAMS, ACTING ASSOCIATE DIRECTOR FOR EMERGENCY OPERATIONS
GEORGE JETT, GENERAL COUNSEL
DENNIS BOYD, COMPTROLLER

BUDGET REQUEST

Senator GARN. The subcommittee will come to order.

Mr. Giuffrida, I want to welcome you and your staff here this morning for your annual appearance.

FEMA is responsible for supervising Federal efforts to anticipate, prepare for, and respond to major civil emergencies. The Agency also works to ensure the effectiveness of the national civil defense program as well as the availability of civil defense systems and resources in coping with all major disasters. FEMA coordinates the programs aimed at preventing and mitigating the effects of potential disasters and the programs designed to deal with these disasters once they occur.

This year FEMA is requesting $396,058,000 for emergency management planning and assistance; $100 million for the disaster relief fund; $200,205,000 for the national flood insurance fund; and $134,014,000 for salaries and expenses. This represents a 32-percent increase from the fiscal year 1984 level.

As you know, we have another agency to hear from this morning, so I would appreciate it if you would summarize your remarks. We will, of course, be happy to place your entire statement in the record.

Again we are happy to have you before us today. Please proceed.

Mr. GIUFFRIDA. Thank you, Mr. Chairman.

PREPARED STATEMENT

We are aware, as you said, of your tight schedule, and I am perfectly willing to have my comments simply included in the record and proceed with the hearing.

[The statement follows:]

STATEMENT OF LOUIS O. GIUFFRIDA

Mr. Chairman and Members of the Subcommittee:

We appear before you today to present testimony on the budget request of the Federal Emergency Management Agency for Fiscal Year 1985.

The total request is for $830,277,000 in budget authority, $747,203,000 in outlays and 2,694 full-time equivalents. Compared to 1984, appropriations increase by $315,098,000; outlays decrease by 54,777,000; and full-time equivalents increase by 88. Of the $315,098.000 in new budget authority, $162,684.000 is for the National Flood Insurance Fund and $100,000,000 is for the Disaster Relief Fund, for an actual increase to direct FEMA operating programs of $92,414,000. The specifics of these changes are detailed in the Budget Justification. This statement addresses the status of the Integrated Emergency Mangagement System and other significant issues in the budget request.

INTEGRATED EMERGENCY MANAGEMENT SYSTEM (IEMS)

There is a range of statutes and executive orders which mandates protections for individual Americans, their property, and the society at large against a full spectrum of hazards and perils faced by the population. These mandates address a partnership with other Federal agencies, State and local governments, private industry and voluntary organizations. FEMA programs are designed to support the mission to help save lives and property. The principal goal is to ensure that Americans are served by a system that provides a coordinated, predictable, and effective response to any emergency regardless of its nature or cause in peacetime or war.

The programs and policies of FEMA are implemented through the Integrated Emergency Management System (IEMS). In 1984 FEMA began to implement integrated emergency management, including field testing. Fiscal Year 1985 will see nationwide deployment.

This integrated approach is being applied to programs within the Agency, on an inter-agency basis in the Federal Government, and within State and local governments. FEMA is practicing at the Federal level the integrated emergency management it advocates for all levels of government. Examples of such IEMS activities include, among many others:

- o Operation of a 24-hour, state-of-the-art Emergency Information and Coordination Center (IECC) at the Headquarters building in Washington, linked to the White House Situation Room, National Warning Networks, the Defense Department, other Federal agencies, the FEMA Regions and the States. The EICC provides a means through which government leaders may coordinate national support in any major emergency.

- Development of an integrated system of emergency telecommunications, warning, automatic data processing, and information for use by civil government in emergencies of all types.

- Training in all-hazards emergency management for elected and appointed officials at all levels of government.

- Tests and exercises in which all levels of government prepare for coordinated, integrated operations in domestic and national security emergencies of all types.

- Substantive modification of Civil Defense program elements so that virtually all activities are multiple-hazard in nature.

- Providing to State and local governments IEMS guidance documents in four areas: an overview to the IEMS process; how to conduct a hazard analysis for each community; standards and a method to assess present capabilities; and multi-year program development planning. This logical approach is being widely accepted by local governments.

- Preparedness guidance is also provided to Federal agencies on actions to mobilize personnel and resources to manage the full spectrum of domestic and national security emergencies.

In our field work, internal operations and inter-agency coordination, the principle behind the Integrated Emergency Management System is that effective emergency management requires capabilities in functions common to all hazards. Enhanced or special capabilities are then developed for specific emergencies.

FEMA was established--by Executive Branch and Congressional action--to foster the development of a truly comprehensive national system for emergency management and to provide a useful infrastructure at Federal, State and local levels and in the private sector to plan for, mitigate, respond to and recover from emergencies of all types. Adoption of the integrated emergency management concept conforms with the mandates of Congress, particularly in the 1980 and 1981 amendments of the Federal Civil Defense Act, and also conforms with the Presidential directives.

This approach is sound on a number of common-sense grounds including economy; multiple-use of limited tax dollars; and increasing the effectiveness of government in dealing with emergencies of all types, including those emergencies which threaten the lives of people, in various jurisdictions, nearly every week.

Recently, the Mayor of Miami, the Honorable Maurice Ferre, signed a proclamation which commended FEMA for "...its comprehensive emergency management strategy to prevent...loss of life and property... for its establishment of the National Advisory Committee representing all types of emergency management officials to examine the problems of local emergency management officials...for the establishment of the Integrated Emergency Management System as an all-hazard...intergovernmental strategy, employing both public and private sector resources...." The City, in its proclamation, also strongly supports the national commitment to IEMS. It will participate in its development and encourage individuals to become involved in its implementation.

While IEMS underlies every aspect of emergency operations, the budget requests for the individual programs and supporting activities remain consistent with the several legislative authorizations on which FEMA activities are based.

WESTERN TRAINING FACILITY

Highly trained emergency managers are essential to effective emergency management. FEMA promotes the professional development of this Nation's emergency managers through the National Emergency Training Center. To provide for a broader training base nationwide, this budget request provides $3,165,000 for the establishment of a second facility in Carson City, Nevada, to augment the NETC facility in Emmitsburg Maryland. Acquiring the new facility will greatly ease the overcrowding on the Emmitsburg campus and enable FEMA to provide a full range of training opportunities more efficiently for states west of the Mississippi River.

CIVIL DEFENSE

The 1985 request for Civil Defense activities is $252,478,000 and 703 full-time equivalents, an increase of $83,274,000 and 42 full-time equivalents. The program elements represent a comprehensive combination of elements designed to support FEMA's major goal of reducing loss of life and property.

Last year, the Subcommittee expressed reservations regarding integrated emergency management as related to the 1984 request for the Civil Defense Program. It was suggested at the March 15, 1983, hearings that the names of several programs were changed to remove reference to nuclear attack but that these were really only name changes, without changes in substance. The Committee's Report reflected a similar view. However, we believe there have been real changes.

As outlined both previously and in the more detailed material which follows, the Civil Defense program has been changed in a number of substantive ways to reflect the multiple-hazards Integrated Emergency Management System--which is being applied not just to Civil Defense, but across most FEMA programs and activities. Integrated emergency management is of special significance in the Civil Defense program, however, because it is this program which accounts for the preponderance of the Federal Government's support for State and local emergency management personnel as well as for the multiple-hazard programs which improve their ability to save lives where the dangers are--in local jurisdictions throughout the United States and territories.

The more important changes in the Civil Defense program include: broadening activities by FEMA-funded State planners to develop multiple-hazard local emergency plans; expanding activities by State Radiological Defense Officers to address response to all emergencies involving radioactive materials and broadening the shelter survey to identify protection against tornadoes, hurricanes, and other threats. These changes, being made during 1984, are significant substantive changes, not merely changes in name or slight changes in emphasis.

These and other substantive program changes have been made in order to save lives in emergencies of all types. Indications are that integrated planning is being well received by local government officials and emergency management professionals. As an example, the Commonwealth of Massachusetts, one of the leaders in multiple-hazard emergency planning, stresses the functions needed to save lives in disasters of all types.

Over 100 of the 350 cities and towns in that State now have such integrated, multiple-hazard plans which were developed with on-site assistance from the State planning staff funded by this program. During 1984, the State's planners hope to complete the initial hazard analyses for all localities with Massachusetts--providing a basis for locally-tailored, hazard-specific plans for the remaining localities with the State.

You may be interested in a recent sequence of events in the State of Washington bearing on the obligation of government to protect its people. Both Houses of the State Legislature approved language, in an authorization bill, opposed to any type of planning to deal with the effects of nuclear attack. This reflected, of course, the view of those who believe it improper to attempt to save lives should a nuclear conflict ever occur.

The Governor of Washington, the Honorable John Spellman, was of the opposite view--and the laws of Washington provide for a line-item veto. Last month, on February 24, Governor Spellman vetoed the language opposing attack preparedness. The Governor, in his veto message to the Senate, stated:

> "The State of Washington is responsible for the protection of the lives and property of its citizens. This responsibility is expressed in our State and National constitutions and outlined in State and National laws. Although a nuclear attack would be a nightmare, one which would make all other calamities man has suffered seem small, State government is obligated to save as many lives as possible, and it is immoral to prevent government from doing all that it can to saves lives and reduce suffering. The section which I am vetoing would shackle the hands of State agencies in responding to the massive human suffering following an attack. Although there may be little that government can do, it cannot stand by and watch citizens suffer if there are state resources that can be used to provide them some relief.
>
> "Although possible scenarios for a nuclear war can be debated, the fact remains that no one can guarantee that our entire population will be lost in an attack. As long as any of our citizens remain alive, they are entitled to the protection and services of the State. If at all possible, food, water, relief from pain, and shelter must be provided to those in need."

Actual experience has shown that integrated plans work when an emergency strikes. For example, at 4:00 a.m. on Easter Sunday, 1983, a spill of 20,000 gallons of nitric acid threatened a large part of Denver with a cloud of toxic vapor. In a text book operation, the people were alerted by radio-activated sirens and were given evacuation instructions by local officials over local stations of the Emergency Broadcast System. Some 9,000 people were evacuated from a four-square mile area. The effort was directed from Denver's Emergency Operating Center, with the Mayor at the helm throughout. The plans, the warning sirens, the Emergency Operating Center, communications, and other systems and capabilities used at Denver were developed through the Civil Defense program.

Other examples of effective lifesaving responses to emergencies of many types, based on capabilities and systems developed through the Civil Defense program, can be cited. However, for every community with a fair to good level of readiness to protect its people, there are many more that fall short. They lack emergency facilities and communications; they lack training for key officials of the city and county government; they lack, in too many cases, a professional emergency program manager to plan and prepare to marshal the resources of the community to cope with a disaster.

Without realistic and effective preparedness in localities throughout the United States there cannot be national preparedness. And while many local governments are doing their share--and more than their share--the issue, in the last analysis, is one of national policy and for national decision. The Congress outlined the actions required in 1980 amendments to the Civil Defense Act, adding Title V.

In order to comply with the mandate of the Congress, the Administration is accordingly requesting moderate funding for a more adequate program. The specifics of the Civil Defense activity, all of which incorporate the Integrated Emergency Management System, are summarized as follows.

The State and Local Emergency Management program provides the foundation of State and local organizations essential to achieve integrated emergency management capabilities for emergencies of all types. This request is $72,548,000 and 205 full-time equivalents, an increase of $4,134,000 and one full-time equivalent. The purpose of this program is to provide matching funds to support the 1,300 State and 4,800 local professionals in some 2,500 jurisdictions and to provide full funding for 1,300 Individual Mobilization Augmentees who assist State and local offices in preparedness activities and during emergencies.

The request for the Radiological Defense program is $21,157,000 and 33 full-time equivalents, an increase of $9,982,000 and 5 full-time equivalents. This request will provide for 52 on-board State Radiological Defense Officers and for adding another 52 Assistant Reagiological Officers for State staffs. The Radiological Defense Officer role includes preparation for all emergencies resulting in radiological hazards such as transportation accidents involving radioactive materials and nuclear power plant accidents. The request under this program also provides for initial private sector production of dosimeters, for continuing maintenance and calibration of more than 4.2 million radiological instruments procured in the 1960s, and for intensified development of a low cost Ratemeter for the full spectrum of radiological and technological emergencies.

For the Population Protection program, the request is $30,455,000 and 166 full-time equivalents, an increase of $11,727,000 and 15 full-time equivalents. This program, which through 1983 emphasized planning to protect the population from nuclear attack effects by crisis evacuation, has been broadened to include multiple-hazard planning at the State and local level, addressing natural and technological as well as war-related hazards. State planners will assist localities to develop plans to protect the population from all hazards determined by vulnerability analyses to be potential threats to each specific locality. This request provides for 170 planners at the State level, in addition to the 205 now on board, to accelerate the development of these multiple-hazard plans for population protection.

This request provides for expanding the Facility Survey, Engineering and Development element of the Population Protection program to identify facilities required to protect people from natural and technological hazards which may affect a local jurisdiction. All-hazard surveys will be initiated on an accelerated basis. In addition, FEMA will identify crisis shelter upgrading and shelter development options by which communities can realistically address shelter deficiencies.

The request for the Protection of Industrial Capability program is $5,566,000 and 6 full-time equivalents, an increase of $866,000 and 6 full-time equivalents. The request reflects a broadening of the thrust of the program beyond the original focus of developing means for protecting key-workers and critical industries against enemy attack. It now includes the IEMS focus on the development of common functional capabilities for dealing with the full range of potential hazards. This program element is particularly important in view of the fact that industry has evidenced clear needs for assistance in this area that has not been provided by the Federal Government to this point.

The 1985 estimate for the State and Local Direction, Control and Warning program is $34,113,000 and 65 full-time equivalents, an increase of $13,147,000 and 13 full-time equivalents. This request provides for continuing the development of State and local Emergency Operating Centers, essential for control of operations by key local and State officials in all types of emergencies; funding to State and local governments for survivable warning and communications systems; and electromagnetic pulse protection for broadcast stations and Emergency Operating Centers.

The estimates include $10,258,000 and 19 full-time equivalents for the Research and Development program, an increase of $3,750,000. R&D activities will explore ways to achieve real increases in capabilities in such common emergency management functional areas as warning; communications; evacuation; food, water and emergency medical systems; as well as economic recovery from catastrophic disasters. Research activities will emphasize taking advantage of other Federal research resources in assessing the nature and characteristic of potential emergencies in support of FEMA efforts to develop means for improved mitigation of hazards, preparedness measures and response capabilities.

The Training and Education program request is $21,487,000 and 67 full-time equivalents, an increase of $3,682,000 and one full-time equivalent; of this amount, $1,394,000 is for the establishment of the Western Training Center. The thrust of this program is to improve the ability of State and local communities to deal with emergencies and disasters of all types. The program includes curricula and courses for policy-level officials, business and industry personnel, and the public. The request will suppprt the training of emergency management skills to emergency services personnel, volunteers and policy officials in a variety of areas, including radiological emergency response, shelter management, and broad participation by government officials at all levels. It will also emphasize real-time, scenario-based, exercise courses for public officials to simulate a high-stress emergency environment, thus improving their ability to execute emergency plans and conduct lifesaving operations when an emergency strikes.

FEMA can do this job well, because FEMA has already given exercise-based training to the key officials of a number of jurisdictions at the Emergency Management Institute. Participants in these courses have included the chief executives and key officials of Arlington, Virginia; Alexandria, Virginia; Atlanta/Fulton County, Georgia and Rhea, Meigs and McMinn Counties, Tennessee.

The exercise, which forms a major part of the course, is tailored to the jurisdiction whose officials are being trained. It is based on a simulated disaster of a type which has affected, or is likely to affect, their own jurisdiction.

Last month, Mayor Tom Bradley of Los Angeles and eight of the City's department heads participated in an emergency management course at Emmitsburg, with a full-day exercise based on heavy coastal storms in the Los Angeles area, a severe hazardous materials accident and a terrorist threat. A similar course was delivered on-site in New Orleans--with emphasis on helping them plan for the World's Fair. This month, plans are to have the officials of Metropolitan Dade County, Florida participate in a course at Emmitsburg--emergency management training in which Governor Graham and Senator Chiles have alredy shown strong interest.

The need for training in emergency management was highlighted in a 1983 conference of elected officials at which NETC staff members distributed a questionnaire dealing with emergency management basics. The questionnaire asked whether respondents knew the answers to such policy questions as who has authority to use schools as shelters in a local emergency? Who can declare such an emergency, and what authority does this confer? Can private property by commandeered in an emergency and if so, who pays for such use? If a hospital needs to be evacuated, who bears the cost and any liability which may result? Who can order an evacuation of the population, and in what circumstances? Who is in charge? Few of the officials knew the answers to those questions.

The request for the Telecommunications and Warning program is $53,815,000 and 122 full-time equivalents, an increase of one full-time equivalent and $34,788,000. The major emphases of the 1985 request are to initiate deployment of a survivable, low-frequency and meteor burst radio warning system (including capabilities to activate warning receivers in, for example, an area threatened by tornadoes or a flash flood); acquire mini-computer regional switches which will provide a secure network capability; replace mid-1950s vintage radio equipment at six FEMA Regional locations with modern high-frequency equipment; replace radio equipment at all State locations with modern equipment; and provide a secure Automatic Branch Exchange for the FEMA Headquarters, FEMA Regional Offices and Federal Regional Centers. These improvements are essential to deployment of the National Emergency Management System (NEMS), which provides for reliable, survivable communications across the spectrum of potential emergencies and disasters. NEMS is to the civilian side of government what the National Military Command System (NCS) is to the military. It is an integral and critical element of the Integrated Emergency Management System.

A recent experience illustrates vividly why it is imperative to move as quickly as possible to the maximum use of radio communications and away from lesed land-lines. It was necessary to move a "call director" telephone from one location to another in FEMA's National Warning Center at NORAD Headquarters in Cheyenne Mountain. The charge for this kind of routine job used to be about one hundred dollars. We were shocked when we found that the bill for this job--following AT&T divestiture--had risen to over twenty-one hundred dollars.

COMPREHENSIVE EMERGENCY PREPAREDNESS PLANNING

For Comprehensive Emergency Preparedness Planning, the request is $8,181,000 and 48 full-time equivalents, an increase of $1,190,000 over the current year. The programs which comprise this activity are designed to enhance State and local capabilities to prepare for, respond to and mitigate disasters and emergencies including natural and technological disasters such as explosions, release of hazardous materials and possible nuclear power plant accidents. All of these activities will be undertaken within the functional multi-hazard concept of the IEMS. An increase of $2,000,000 for the Earthquake program is requested to allow for such projects as: a study to examine the feasibility of and the need for an earthquake experiment facility; the initial preparation of a State and local government manual on evaluating existing structures; initial preparation of model codes for existing structures; and an increased effort to develop and disseminate to State and local governments easily-applied mitigation techniques. This increase is partially offset by a $450,000 decrease to the Hurricane program and a $400,000 decrease to the Dam Safety program. These decreases result from continuing emphasis on the part of State and local governments to provide matching funds for these activities, as well as, the use of inherent State authority for the programs in some States.

RADIOLOGICAL EMERGENCY PREPAREDNESS

For the Radiological Emergency Preparedness program, the request is $6,113,000 and 67 full-time equivalents. The goal of this program is to develop State and local offsite radiological emergency plans for fixed-nuclear facilities. Through plan development and the exercising of these plans, the program seeks to achieve reasonable assurance that appropraite protective measures can be taken offsite in the event of a radiological emergency. This request provides for a continuation of review and final determinations on offsite emergency preparedness at site-specific commercial nuclear power plants as well as observation and evaluation of State and local exercises to assure public safety. Emphasis will be placed on refining the Federal response plan for radiological emergencies and on increasing alert and notification testing.

FEDERAL PREPAREDNESS

FEMA's Federal Preparedness program guides and facilitates efforts of the Executive Branch to prepare for and effectively respond to the full spectrum of emergencies. Our goal is to attain the capability to deliver coordinated, predictable and effective management of Federal mitigation, response and recovery activities relating to major domestic emergencies and national security emergencies. This capability is a key element of the IEMS. It encompasses planning and preparedness pertaining to all national resources. We have made and are continuing to make incremental improvements in the readiness capabilities of FEMA and of the other civil departments and agencies responsible for preparedness of the nation's resources. The request for this activity is $139,682,000 and 920 full-time equivalents, an increase of $8,133,000 and 40 full-time equivalents.

An integral part of this goal to deliver effective emergency management is the capability to sustain performance of the key functions and organizations of the Federal Government and to assure continuation of leadership throughout all phases of emergencies.

There is a need to improve the effectiveness of FEMA's ability to manage the Federal response to emergencies. This requires improving the capability to mobilize resources, to periodically evaluate readiness and to take needed corrective actions. An increase of $1,000,000 for mobilization preparedness is requested to provide new approaches in effective management systems, readiness exercises, organizational structures and relationships, staff augmentation and analytical evaluation tools, techniques and procedures.

TRAINING AND FIRE PROGRAMS

For the Training and Fire programs, the request is for $25,043,000 and 106 full-time equivalents, an increase of $7,569,000 and 6 full-time equivalents. $1,771,000 of this amount is for the establishment of a Western Training Center; $2,074,000 is for additional course offerings in the Emergency Management Institute for expanded delivery of the new course for community emergency management teams; $1,204,000 will enable the National Fire Academy to offer an additional 203 course offerings to 8,000 students in the field; and, $2,520,000 will enable the U.S. Fire Administration to begin work in fire codes, better code enforcement practices and a national residential sprinkler protection program which will pursue, in conjunction with the private sector, the creation of the fire-safe home across America.

FLOOD PLAIN MANAGEMENT

The 1985 request for Flood Plain Management is $53.639,000 and 214 full-time equivalents, a decrease of $12,223,000 from 1984. This decrease, which is in the area of new studies, will allow FEMA to reassess its flood study effort in light of a report due in 1984 on demographic and flood plain development patterns.

NATIONAL INSURANCE DEVELOPMENT FUND

The budget request this year for the National Insurance Development Fund reflects phase-out of the Riot Reinsurance Program, which expired November 30, 1983, and termination of the Crime Insurance Program when its authority expires September 30, 1984, as provided for in the Housing Act of 1983.

NATIONAL FLOOD INSURANCE FUND

For the National Flood Insurance Fund, an appropriation of $200,205,000 is requested to be used to repay borrowings against the $1 billion borrowing authority. This represents an increase of $162,684,000 over the amount appropriated in 1984, and is the result of greater than normal flooding during 1983. The objectives are to make this program self-supporting by 1988, to operate the program on a more business-like basis while encouraging prudent decisions regarding areas affected by the flood hazard, and to increase insurance industry involvement in the program.

DISASTER RELIEF

Under the Disaster Relief Act of 1974, FEMA is authorized to administer disaster assistance programs and to manage and coordinate the total Federal response to Presidentially-declared major disasters and emergencies. $100,000,000 is requested in new budget authority for 1985. This request will provide $468,494,000 in obligational authority which is necessary to provide Federal assistance to supplement resources of State and local governments.

SALARIES AND EXPENSES

The 1985 request for Salaries and Expenses is $134,014,000 and 2,694 full-time equivalents, an increase of $11,840,000 and 88 full-time equivalents. This appropriation provides the salary and other costs required to provide executive direction, administration and staff support to FEMA's programs in the headquarters and field offices.

The $11,840,000 increase will provide full-year funding of the January 1984 pay raise, cost of within-grade step increases offset by savings from filling vacancies in GS-11 through GM-15 with lower graded positions and funding for 88 addditional full-time equivalents requested for activities in Civil Defense, Federal Preparedness and Training and Fire programs.

In summary, Mr. Chairman, the request before the Committee will support the President's commitment to improve the nation's state of emergency preparedness, its national security posture, and the life and safety of its citizens.

Thank you, Mr. Chairman. My staff and I will be pleased to answer any questions.

FEMA ACCOMPLISHMENTS

Senator GARN. Well, that is the shortest opening statement I have ever heard. You would never make it as a politician speaking that briefly.

Looking at your accomplishments over the last year, what would you feel was FEMA's most significant accomplishment? What are you most proud of that FEMA has done?

Mr. GIUFFRIDA. Well, I am understandably proud of all that the FEMA team has accomplished, sir, in the past 3 years. As a matter of fact, as part of my preparation for this hearing, I reviewed what we found when we got here. We found an agency that existed de jure but was not yet de facto; no organization of any kind. With the help of the GAO and the OMB, from whom I requested, as you recall, baseline audits, FEMA has gone from that to the point where we are getting compliments from all the committees on the Hill, which I consider is a significant apolitical accomplishment.

I think the thing I am proudest of that the FEMA team has been able to provide to the United States as part of the Government's responsibility for protecting the lives of its citizens, is the integrated emergency management system (IEMS). IEMS was not fully understood because of a combination of factors including my failure to explain IEMS adequately last year and a lack of knowledge on the part of some of the people who were critical of it. There is, in fact, no better arrangement for any government, in my judgment, sir, than coordinating the efforts of all of the departments of government, in coordination with the States and the local governments, to put in place a system of responding to the threats—natural, manmade, and otherwise—which is predictable and effective and coordinated. Also, it must be in consonance with American traditions as they go back 208 years. We are well on the way to achieving this goal through FEMA. The U.S. arrangement is singular in the Western world and, for that matter, I think in the entire world.

IEMS has now become a matter of great interest to our allies, particularly in NATO, and we have an increasing stream of exchanges among us in even such disparate places as Liberia and Finland. All are trying to find out how this system is structured or how a government goes about trying to structure an integrated system which will improve emergency management for all hazards and which has implicit in it the necessity not only to explain to the constituents what is involved, but also the requirement to get the money to fund it.

5-YEAR PLAN FOR CIVIL DEFENSE

Senator GARN. As you know, the Senate Republican leadership and the administration have agreed on a so-called down-payment deficit reduction package of $150 billion. Essentially, that package was approved by the Senate Budget Committee yesterday and in some parts of that there is agreed upon a freeze proposal which will certainly have an impact on all of the agencies within the jurisdiction of this subcommittee if it is passed. In anticipation of that kind of proposal we have been asking FEMA since February to prepare a revised plan for your civil defense program. We have asked for this plan because Congress has not provided the funding level requested by civil defense in the past and we want as good a civil defense program as we can possibly come up with regardless of the level of funding. To be frank about it, so far we feel that we have received a rather sketchy response. We are trying to be helpful, but it becomes rather difficult to argue for increases in the program when we are not getting the basic information from FEMA.

Is it possible for you to prepare a 5-year plan for us that would be responsive to the committee's request of February?

Mr. GIUFFRIDA. Yes, sir, we can. I would hope that the committee recognizes that our failure to provide what the committee staff sought was not to withhold or to fail to provide. I think it was an instance where there was not a fair understanding. We can provide for the record what it is they seek.

Senator GARN. Would it be possible to do that by May 1?

Mr. GIUFFRIDA. Yes, sir.

FREEZE ON CIVIL DEFENSE EXPENDITURES

Senator GARN. Could you comment on what the implications of the freeze would do on the civil defense program?

Mr. GIUFFRIDA. Well, Mr. Chairman, we need the committee's assistance in clarifying what is meant by civil defense and the impact on our ability to respond; that is, an inevitable consequence of FEMA's requirement to report to the authorizing and Appropriations Committees. Last year FEMA made in excess of 80 appearances on the Hill. That is an extraordinary number of appearances for an agency which numbers some 2,700 or 2,800 people. The truth of the matter is that we have, in effect, taken all of our money and put it, irrespective of where it comes from, into a common checking account. So that when we say "civil defense," we are including money that comes into that appropriation and goes over, for example, into training and does other things to improve emergency management.

The system that we have been trying to construct for the past 3 years has been designed to increase the ability of State and local governments to respond, in conjunction with the Federal Government, as effectively as possible, to expedite the system and to get people trained. This goes beyond the traditional training patterns that we have had in the past of bringing people for short courses. FEMA has been involved for 2 years, for example, with the Association of Colleges and Universities that award degrees in public administration, and this past September we had the first 4-year curriculum program on public administration.

What I am trying to lead up to, sir, is that a reduction in funds will have an inevitable fallout on our ability to provide emergency operation centers and to update communications and data equipment, some of which is older than the people sitting behind the desk using it. The equipment is 1950's vintage. I am trying, with my staff, to retain as much emphasis as I can on training. Training seems to me—and we have discussed this in previous appearances before your committee—to be the mechanism that we need to have to bring from transients such as I, to the nontransient segments of government where most of the institutional memory is retained.

That is kind of a wordy way of saying what the impact is going to be. It means that we won't be able to provide to States and locals as much help as we would have provided.

INTEGRATED EMERGENCY MANAGEMENT SYSTEM

Senator GARN. In your opening statement you indicate that you began to implement an integrated emergency management system in fiscal year 1984, including field testing. Could you describe the field testing for the subcommittee?

Mr. GIUFFRIDA. With your concurrence, Mr. Chairman, Mr. McLoughlin will take that.

Mr. MCLOUGHLIN. Senator, in 1984 we started with interim hazards analysis guidance for State and local governments, a capability assessment that is measured against a set of standards and a multiyear development planning process. The State and local governments have been involved in all of those and we have had some specialized field testing in each one. We are planning to make some changes in the guidance for fiscal year 1985 as it is administered in the field and we are also this year working on an automated system so that the State and local governments would have the option of whether or not they would use a manual system or use the automated system to be able to annualize the data more effectively.

Senator GARN. You plan a nationwide deployment in fiscal year 1985. What test and evaluation do you anticipate during 1985?

Mr. MCLOUGHLIN. We plan to continue the field testing in 1985 and it is the automated system, in particular, that we hope to deploy nationwide during that period.

TELECOMMUNICATIONS AND WARNING

Senator GARN. One of the largest increases in the FEMA budget is the telecommunications and warning systems. The request for fiscal year 1985 of $53,815,000 is an increase of 120 percent over fiscal year 1984. A funding increase is required to build and secure a highly reliable system to replace the existing equipment that is mid-1950's vintage and dependent on leased communications lines which are susceptible to potentially large tariff increases.

If we were to fund the entire fiscal year 1985 telecommunications and warning system request, what percentage of the modernization program funding requirements would we have paid for?

Mr. GIUFFRIDA. I am going to ask Mr. Williams to answer that, Mr. Chairman.

Mr. WILLIAMS. Senator, we have, basically, a 5-year program to upgrade the warning systems and the telecommunications. We are front loading the program in the first 3 years. Within the civil defense program, the answer to your question is that approximately 52 percent will be completed and upgraded by the end of 1986. We would have budget increases this year and next and then the program would level, and at the end of the 5-year program we would be in a maintenance operation.

Senator GARN. Are the components to the system being purchased under a competitive bidding?

Mr. WILLIAMS. Where we have agreements with the telephone companies and AT&T, for example, we would be funding them to upgrade the equipment in accordance with our service contracts. Where we do not have these arrangements, we would go to the full competitive procedures.

Senator GARN. Is all the hardware compatible?

Mr. WILLIAMS. Sir, the hardware in the old system in many instances is not compatible. Everything that we are doing from last year out is aimed at integration so that all systems will be interoperable, not only at the Federal level, but also at the State and local level.

Senator GARN. Do you feel that the completed system will meet the needs of FEMA through the 1990's?

Mr. WILLIAMS. Yes, sir. We are looking now at digital systems and advanced technologies that are not research and development, but basically off the shelf and have very high reliability. Looking at such issues as EMP and the capability of the networks that move communications into digital systems, we feel that we will be in the nineties and beyond with our systems.

ACCIDENTAL DISSEMINATION OF WARNING

Senator GARN. Time magazine in their January 16, 1984, issue reported that the Pennsylvania Emergency Management Agency in Harrisburg, Pa., had erroneously relayed an attack warning message to 44 county civil defense agencies. In Lehigh County the nuclear attack sirens were set off. Most Pennsylvania county officials chose not to broadcast the message before they could confirm it. In Allentown, Lehigh County's largest city, most residents took the sirens—some dating back to World War II—as a fire alarm.

What kinds of lessons do you learn from that kind of thing? Is there anything in situations like this that are helpful?

Mr. GIUFFRIDA. Yes, sir, there are. I ask Mr. McLoughlin, under whose responsibility that falls, to answer the question for us.

Mr. MCLOUGHLIN. Senator, as you pointed out in addressing the question, they were installing new equipment in this instance and there was an accidental dissemination of the warning information. If we had been in an international crisis at that point, people would have probably automatically, and we would expect automatically, have sounded the warning sirens. We think their reaction was reasonable at that point. There was no hurricane watch, certainly there was no tornado watch, there was no international crisis, and the warning has to be taken within the context of the environment at that time.

In most instances, including Lehigh County, they called back into the Pennsylvania Emergency Management Agency to determine and confirm that this was indeed a natural warning. Lehigh County disrupted that communication and sounded the warning before they were given the fact that it was a false message. The same thing I think, from our perspective, is true with the population as a whole, it has to be taken into context and when those warnings were sounded, it was not in the context that people would have expected an emergency to have occurred.

Senator GARN. Do you think we have developed such a complacency over the years though that most people would ignore a warning siren? I have to be honest and say when I hear a siren go off sometimes my first reaction is, well, somebody goofed, there is nothing going on. I feel that is sort of a general perception. People just go on about their normal business without regard to those types of warning.

Mr. GIUFFRIDA. I think there is a certain amount of reality in that statement, Senator. I think though that a couple of other things have to be considered. Most of us have been conditioned to consider fire sirens in the context of a fire alert. People who are younger than I have no frame of reference from actual experience with a civil defense warning. Their reference comes from either old movies or from deliberately slanted caricatures that appear on the television or in some of the media.

The third factor is that some of the equipment is obsolete, or virtually on the edge of obsolescence, but I think the most important thing is not apathy, I think it is lack of knowledge, and that is one of the things that we have been trying to address. This was brought up last year, if you recall, in our conversation. People are not apathetic; they are uninformed, and the trick has been for us to try to find the proper mechanism for educating them without alarming them, for being objective and factual and at the same time go back and correct publications which were prepared in 1950 or 1960, but which have since been overtaken by new developments.

I conclude by saying I don't think it is apathy; I think it is lack of knowledge.

BEHAVIORAL SCIENTISTS

Senator GARN. How many behavioral scientists on your staff have been involved in developing planning programs which feature anticipated citizen reaction to the emergency warning system?

Mr. GIUFFRIDA. We don't have any behavioral scientists as such on the FEMA permanent staff, but we have access to behavioral scientists through the various contracts and consultants. They are involved. Some of us have studied this phenomena in the past. There is a considerable amount of literature on it, but as with every other scientific effort, there are disagreements within that particular scientific community. However, behavioral scientists are involved but not as regular members of the staff.

Senator GARN. I should not say this, but as the father of seven children, I don't know that you can call behavior a science in any event.

Mr. GIUFFRIDA. As the father of five, I agree.

EMERGENCY MANAGEMENT ASSISTANCE PROGRAM

Senator GARN. One of the largest items within the FEMA budget is the emergency management assistance program within State and local emergency management. The budget justification contains $58 million for 50-percent matching grants to support eligible State and local emergency management agencies. While the FEMA funds may be used for salaries, travel expenses, and other administrative costs, it is understood the funds are for accomplishments not funded by other means that also increase emergency preparedness capability.

What oversight do you exercise as being over these funds?

Mr. MCLOUGHLIN. Senator, the funds are distributed according to an allocation formula that involves 50 percent for the previous year's development and about 33 percent for population, about 10 percent for the EMA population of that State, and about 5 percent for each State. What we do then is to pass that money to the States through our comprehensive cooperation agreements, and that is a negotiated process with each individual State between our regions and the States.

What we try to do in that process is to negotiate a set of products or outputs that are definable for those dollars. Then part of our oversight also includes during the last quarter going back to each of the States to determine whether or not there are going to be any surpluses in their official application. If there are, we pull those facts in and redistribute to the other States that do not have enough funds in their initial allocation.

DOSIMETERS

Senator GARN. The subcommittee has previously expressed some concern about the high levels of light needed for the dosimeters to be read. What studies have you done to define the light levels required to reach the high-range dosimeter and the low range?

Mr. MCLOUGHLIN. Senator, we have been aware of the committee's concern on that part. We have had the Oak Ridge National Laboratory that provides us with basic technical assistance in the development of time barred dosimeters to restudy and relook at the light question. Part of the problem is the way in which the light is focused in the dosimeter and the way in which the lens in the dosimeter has been moduled. We are redesigning the dosimeters to take account of both of those corrections and it will be included in our production activity in North Dakota.

Senator GARN. What is the lighting level?

Mr. MCLOUGHLIN. Our intent is to provide a dosimeter that can be read, basically, with candlelight in a shelter. That is the minimum level that we would like to be able to use in the field test.

Senator GARN. What consideration have you given to the redesign of the instrument so that they could—and you have already partially answered that—function under office lighting or the level of lighting found in the shelters? Can you give me a little more detail on that redesign?

Mr. McLoughlin. Generally speaking, Senator, it has to do with refocusing the lens in the optical system plus the transmission of light through the dosimeter. With those two corrections we believe that we can produce a dosimeter that will be able to be read in shelters by candlelight.

Senator Garn. How much have you included in the fiscal year 1983 budget for the production of that instrument?

Mr. McLoughlin. About $5.1 million.

Senator Garn. Could you submit a detailed breakdown of your budget request for the design of prototypes and production costs of the dosimeter, including the number to be produced?

Mr. McLoughlin. Yes, we can.

[The information follows:]

Design of Dosimeters

We have allocated $5,150,000 for the production of dosimeters. This includes funds for the Rolla facility to support mass production by helping to solve the inevitable production problems, helping to make and prove out necessary design improvements, and to monitor the quality of the production by the private sector. An additional $500,000 is required for engineering support by Oak Ridge National Laboratory and the FEMA, Emergency Management Systems Test Facility. The following is our best estimate of requirements for fiscal year 1985 for dosimeters:

Technical assistance	$500,000
Pilot production by Rolla	1,300,000
Quality assurance by Rolla	200,000
Startup of mass production by the private sector	3,650,000

The number estimated to be produced by the private sector is 100,000 low-range (200 mR) dosimeters.

NATIONAL EMERGENCY TRAINING CENTER

Senator Garn. You stated that from June 1, 1983, to February 17, 1984, 2,203 qualified students would be turned down at NETC. Please provide a percent distribution by State for those students that are rejected.

Mr. Giuffrida. I will provide that for the record, sir.

[The information follows:]

DISTRIBUTION OF REJECTED STUDENTS

The following is the percent distribution by State for those students that are rejected:

	Percent
California	16
Colorado	5
Florida	6
Arizona	3
Missouri	3
Oregon	4
Texas	4
Utah	5
Washington	9

The remaining States each had 2 percent or less.

ADJUNCT FACULTY

Senator GARN. Would you please also provide for the record a list of the States of residence for all the adjunct faculty?

Mr. GIUFFRIDA. Yes, sir, for the record.

[The information follows:]

DISTRIBUTION OF ADJUNCT FACULTY

The following is the number of adjunct faculty from each State which are used in the Emergency Management Institute and National Fire Academy resident programs:

	Emergency Management Institute	National Fire Academy
Alabama	0	0
Alaska	0	0
Arizona	0	9
Arkansas	0	0
California	15	44
Colorado	0	11
Connecticut	2	3
Delaware	0	2
District of Columbia	6	1
Florida	5	8
Georgia	3	4
Hawaii	0	0
Idaho	0	1
Illinois	5	9
Indiana	3	4
Iowa	0	0
Kansas	0	1
Kentucky	2	4
Louisiana	1	4
Maine	1	3
Maryland	13	24
Massachusetts	6	7
Michigan	1	16
Minnesota	0	1
Mississippi	1	0
Missouri	4	6
Montana	1	1
Nebraska	0	1
Nevada	0	1
New Hampshire	0	0
New Jersey	0	4
New Mexico	1	0
New York	4	20
North Carolina	1	11
North Dakota	0	0
Ohio	1	7
Oklahoma	0	6
Oregon	0	3
Pennsylvania	8	22
Rhode Island	1	1
South Carolina	1	1
South Dakota	0	1
Tennessee	1	11
Texas	2	10
Utah	0	4
Vermont	0	1
Virginia	9	16
Washington	2	9
West Virginia	0	1
Wisconsin	0	0
Wyoming	1	1

WESTERN TRAINING FACILITY

Senator GARN. The subcommittee asked for a cost-benefit analysis of the alternative. It seems what was provided was a comparison of the cost of renting space in Carson City versus Washington, DC, and the implications of transportation costs. I think the subcommittee had more in mind than that. Could you develop a revised cost-benefit analysis for the committee by May 15?

Mr. GIUFFRIDA. Yes, sir, we will.

Senator GARN. And could you include in this report the cost of the agency not adding any additional training facilities, attempting to take some of the courses to each of the regions each year, expanding NETC, and other options in addition to NETC West?

Mr. GIUFFRIDA. Yes, sir. We will do all that by the 15th.

U.S. FIRE ADMINISTRATION

Senator GARN. The U.S. Fire Administration has taken $700,000 of the $1 million appropriated above the fiscal year 1985 request to initiate a community-based volunteer program in 10 States. What is your plan for this program for fiscal year 1985 and 1986?

Mr. VILLELLA. Mr. Chairman, I would like to preface a response to that question by commenting that there is a tremendous amount of progress that has occurred prologue to where we are this year in 1984. I think there is a consequence of that work. We sit on the threshold of two advancements; one is that of technology. There have been substantial advancements in technology to improve fire protection systems and the other threshold is added cooperation. There is an increasing amount of cooperation from community-based activities, from the industry, and from fire service volunteers among others.

We went into the community-based volunteer fire prevention program last year as a consequence of funding that was provided by this committee and we have had the growth factor which is now provided, that we have 10 States who will participate. Plans are to double that participation next year and to encourage the continuing amount of volunteer participation from other communities within the other States that conform to the same basic process of a community-based program.

Senator GARN. To achieve maximum effectiveness would any future funding be required in the same 10 States?

Mr. VILLELLA. Sir, our plans are that we would add more States and that funding each year would decrease, Federal funding, and that we would ask for more funding in 1986 and 1987. We think the program would be totally completed by 1989.

SPRINKLER SYSTEMS

Senator GARN. The fiscal year 1985 budget request increases the fiscal year 1984 appropriation for fire prevention/arson control by $2.5 million to a level of $3.65 million. This is to emphasize full utilization of sprinkler systems, standardizing fire code, and more effective code enforcement practices.

Would you briefly describe your multiyear priorities in these areas in the long-term anticipated payoffs, in terms of reduced fatalities, injuries, and property loss?

Mr. VILLELLA. Mr. Chairman, I would like to provide a detailed response for the record. However, I would like to say that we have substantial evidence that fire protection systems, all those who participated, can be effective in saving 80 percent to 90 percent of the lives presently lost from fire in residences which account for 80 percent of the 6,000 annual life loss.

[The information follows:]

FIRE PREVENTION STRATEGIES

The basic strategies that the program will encourage and enhance are: (1) Fire prevention awareness with respect to activities, behaviors, and reactions of individuals in fire situations; (2) fire safety and survival techniques to save the lives of handicapped individuals and those dependent upon another person for assistance; and (3) installation of fire protection devices being one of the most effective means of saving lives and minimizing property damage.

While there is genuine concern for all segments of our population, special emphasis will be given to the old, the young, the handicapped people that are often incapable of avoiding the tragic consequences of fire.

The anticipated operation of the community-based volunteer fire prevention program is one that expects State and local activities to become self-sustaining within 3 years. Therefore, the funding level for any State is 50 percent of the startup total the second year and 25 percent the third year. It is anticipated that the funding level would remain constant in fiscal year 1985, while rising in fiscal year 1986 and fiscal year 1987 before declining in subsequent years.

SPRINKLER SYSTEM PROMOTIONS

Senator GARN. What amount of funding is proposed for promotional activities relating to sprinkler systems?

Mr. VILLELLA. Mr. Chairman, we have not proposed promotional activities per se but we do propose increased awareness among the respective members that are participating in industry fire associations among others and increased training seminars that are not essentially promotional activities.

Senator GARN. How much are you proposing for sprinkler R&D?

Mr. VILLELLA. Sir, I would like to provide that for the record. I am not sure. There are many results not coming in, and as a result we are working with industry which may include the necessity for a great deal of additional research and development.

Senator GARN. That will be fine.

[The information follows:]

SPRINKLER RESEARCH AND DEVELOPMENT

During fiscal year 1985, the Fire Administration proposes to expend $1 million in the area of sprinkler system R&D. Among the activities that are intended to be accomplished are:

(1) The development of installation standards for unique applications such as sidewall, cathedral ceilings, and occupancies such as hotels, motels, and boarding homes; (2) development of standards for retrofit applications of residential sprinklers in nursing homes and group housing for the deinstitutionalized and the aged; (3) comple-

tion of cost-benefit analysis of residential sprinklers in various occupancy classes; and (4) basic research on new sprinkler designs, materials, and mechanisms.

JUVENILE FIRE SETTER PROGRAM

Senator GARN. Would you please describe the activities and the planning position and associated information pertaining to management systems and juvenile fire center programs for fiscal years 1983, 1984, and 1985?

Mr. VILLELLA. We would like to provide a detailed response for the record.

[The information follows:]

ARSON INFORMATION MANAGEMENT SYSTEMS (AIMS) FY-83-84-85

FY-83 70K (Actual 70,345)

- Demonstration Site - Initiated the AIMS system in six urban cities: Los Angeles, Baltimore, Miami, Houston, New Orleans and Atlantic City. These pilot cities were funded for purchasing a microcomputer and necessary software. Technical assistance was provided for the initial institution of the system.
- Users Manual - Produced a users and documentation manual on how the AIMS system works and how to set the system up.
- Technical Assistance - Provided technical assistance to jurisdictions utilizing AIMS with main frame computers.

FY-84 100K (Actual 102,975)

- The initial six pilot cities are still utilizing the AIMS system with overall satisfactory results.
- Rural AIMS Assessment - The six pilot cities are urban areas and a present USFA funded project is assessing whether the AIMS system can be utilized in a rural arson setting.
- Microcomputer Software - The original AIMS utilized one microcomputer system. An enhancement program funded by USFA will produce 5 additional AIMS packages for use by the fire service.
- National Teleconference - A teleconference was conducted in February 1984 utilizing AIMS for Arson Mitigation. This was viewed by approximately 20,000 individuals throughout the United States.
- AIMS/NFIRS Capability - In conjunction with the Data Section of the U.S. Fire Administration we are looking at the feasibility of incorporating AIMS with NFIRS systems.
- Regional AIMS Workshop - An AIMS Conference was held in Baltimore, Maryland, and representatives of 20 jurisdictions attended. Five of these jurisdictions instituted AIMS systems as a result.
- Technical Assistance - Continued technical assistance to jurisdictions wanting to implement AIMS on main frame computers.
- Information Dissemination - We continue to provide manuals on the AIMS approach to requesting agencies (approximately 60 requests per month).

- As a result of the AIMS pilot cities, numerous other areas have implemented the AIMS approach. A study is presently underway to identify the number of users.

FY-85 (100k)

- Continued updating, modifying and monitoring of the six pilot cities using AIMS.
- Production of an assist AIMS package, consisting of a manual and software containing the program.
- Production of a videotape, to be given to the ten Federal Representatives, providing visual instruction on how to set up and use an AIMS system.
- Adoption of AIMS for rural areas. Modification will be necessary for rural arson as opposed to urban arson.
- Integration of AIMS with NFIRS if feasible.
- Continuing cooperation with the private sector utilizing the AIMS with Community Based Organizations.

JUVENILE FIRESETTERS FUNDING

FY-83 75k	FY-84 15k	FY-85 95k

FY-83 National Conference - A two-day Juvenile Firesetter Conference was held March 10-11, 1984, at the NETC. This conference brought together members of the fire service that are engaged in counselling juveniles along with professionals in the fields of medicine, psychology, education, social services, law enforcement, and insurance, to explore the interdisciplinary network that is necessary to deal with the nationwide problem of juvenile firesetters.

FY-84 Continuation of FY-82, FY-83 Activities

Juvenile Firesetter programs initiated in prior years will be continued. Efforts are being made to coalesce previous efforts by supporting conferences, public information initiatives, the exchange of information and the distribution of available material.

Alternative Methodologies for Interventions

A multi-year project for identifying new, alternative or unexplored methodologies that will improve the intervention strategies required for addressing juvenile firesetter problems is under serious consideration.

FY-85 Juvenile Firesetters (15-18)

The problems associated with the older juveniles will be more fully explored; strategies for dealing with this age group will be delineated and tested.

Program Evaluation

An indepth evaluation of the total efforts undertaken, to control the juvenile firesetter problem will be completed.

National Conference

A conference of practitioners in the various facets of the juvenile firesetter problems will be convened to exchange information and explore methods to enhance the mutual effectiveness of the interrelated disciplines.

Consolidated Manual (Under 7, 7-14, 15-18)

The consolidation of three separate juvenile firesetter manuals, with consolidation of overlapping material will be completed in FY-85.

CIVIL DEFENSE AND TECHNOLOGICAL PLANS

Senator GARN. Last year we asked you to comment on the imbalance of funding between civil defense plans and the natural and the technological hazard plan. Last year's budget request figures indicate you spent almost $16 for a civil defense plan for every $1 for every natural and technological hazard plan. This year the figures are more like 13 to 1. You may note that we still feel flood claim management cannot be considered as emergency response plan. Will FEMA be developing a truly integrated emergency response plan effort over the next 5 years?

Mr. MCLOUGHLIN. Mr. Chairman, the answer to that certainly is "Yes." One of the reasons for the disparity between the 16-to-1 ratio that you commented on is because the Civil Defense Act is the principal authority that we have to help State and local governments build the emergency infrastructure; that is, communication systems, warning systems, emergency operating centers, dosimeters, et cetera.

The other programs, the earthquake money that we get, the hurricane money, the emergency preparedness dollars, there are no hardware authorizations or costs included in those. They are essentially a planning activity. When we build an emergency operating center under the Civil Defense Act it really should be viewed as if it is not only for nuclear attack, but clearly for natural and technological disasters as well. The same is true of communications and warning. In that context the ratio is much closer to a 1-to-1 ratio from our perspective.

Senator GARN. What do you anticipate during the 5-year period will happen to that ratio?

Mr. MCLOUGHLIN. My guess is that the ratio will stay roughly constant, sir, because there are authorities, as I said, for building that emergency infrastructure that are in the Civil Defense Act and, therefore, we would always expect the hardware costs in there to make that part of the budget larger than the others.

EMERGENCY FOOD AND SHELTER PROGRAM

Senator GARN. Well, last year the subcommittee appropriated funding for FEMA to provide grants for State programs and volunteer private organizations to temporarily house and feed needy individuals. What is FEMA's position or feeling about this program after working with it?

Mr. MCLOUGHLIN. Senator, we are prepared to carry out the will of the Congress in this particular area. As you know, this is not an area that is directly related to much of our other activity. Certainly we believe that in the 2 years that we have distributed the funds that we are proud of the work that our people have done and think that they have done a very fine job.

Senator GARN. Well, I think—as you know, I was not in favor of it going through FEMA and I still am not. I don't think that it is an activity that fits with your other programs. One thing you learn to do in the Senate is to compromise when a majority of Senators feel differently. I not only disagreed with it being in FEMA, I didn't like the approach of going to the voluntary private organizations. But, again, that was mandated in a House/Senate conference where, as you probably know, we ended up with both programs. The Senate went in with $50 million and the House $50 million and we ended up with $100 million to do it with private as well as State agencies. I still think it is a bad way to handle the program. I am not talking about the need. I am talking about the mechanics of the way it is continuing to be handled. The program is no discredit to you. We dumped it on you and, under the circumstances, I think you have done as good a job as you can.

What will be changed in FEMA's approach if this were to become a continuing program as opposed to the existing so-called temporary program?

Mr. GIUFFRIDA. Mr. Chairman, I will take that one. If it became a part of our regular schedule of activities we would have to come back to the Congress and ask for more help in helping to ease the problem.

Senator GARN. Well, if it becomes permanent like 200 other programs, you can rest assured I will try and figure out how to get the votes the other way to have it handled differently.

DAM SAFETY

In Utah we are aware of the problems facing the communities in regard to dam safety. Last year you testified that 2,000 of the Nation's 67,000 dams were unsafe and 150 require emergency actions. You also testified that not much was being done in this area. What has been achieved in the last year on the dam safety problem?

Mr. MCLOUGHLIN. Senator, we conducted a series of awareness workshops, we developed and conducted workshops on a new risk analysis basis for non-Federal owners in terms of how to look at the risk of the dams. We have assisted the States by the development of a nationwide organization of dam safety coordinators, and their first conference is going to be in June of this year. We are hopeful that that emphasis focused on a nationwide basis will improve the dam safety conditions.

Senator GARN. Do you feel that we developed a number of emergency plans during fiscal year 1983 and you have reduced the problem?

Mr. MCLOUGHLIN. Senator, the problem essentially has not been reduced markedly. There are only 22 States in the country that legally have adequate dam safety programs. Dams are growing at the rate of about 750 a year in this country, non-Federal dams, and it is probable that unless the other States do indeed get better programs, that the problem will not be improved significantly.

Senator GARN. If there has not been much change, then why do you reduce the funding request in this area by 83 percent from last year's appropriation?

Mr. MCLOUGHLIN. There are two reasons for that, Senator. First of all the view of our Agency is that the dam safety program is essentially one of State and local governments and the private sector because the owner, in effect, is responsible. The other part is that we have in the last 2 years, in 1983 and 1984, provided seed money to the States to try to help them introduce new dam safety regulations and dam safety programs that are adequate. Given that, we want to analyze what we have done with that seed money over the last 2 years before we initiate any new major dam safety efforts.

FLOOD INSURANCE

Senator GARN. On page 514 of your budget justification you indicate that efforts to involve the private insurance issue will continue in fiscal year 1985. It then indicates that, "The impact of the write-your-own program will be analyzed * * *."

Could you briefly describe this program and the benefits you foresee, as well as any potential problems?

Mr. GIUFFRIDA. Mr. Bragg will handle that, Senator; he is the Federal Insurance Administrator.

Mr. BRAGG. Sir, the program is designed to create once again a partnership between the private sector insurance companies and the Federal Government in carrying out the national flood insurance program. To date, for the first year of its implementation, we have 48 companies that have signed arrangements to operate the program with us. We would expect more companies to participate next year.

We think the benefits are threefold. First, it gives the companies experience in dealing in this kind of disaster insurance program. Second, and more important, it provides a higher level of service to our policyholders because we are drawing on the institutional expertise of the private insurance industry in carrying out the program. Finally, it is important because we are able for the first time to harness the marketing and distribution system of private industry, hopefully, to reach a broader segment of the population with this program so that we can expand the policy base geographically and numerically.

SUBMITTED QUESTIONS

Senator GARN. Gentlemen, I have no additional oral questions for you today. I do have 35 pages of additional written questions for your response in writing. The good news is I have no more oral questions and the bad news is 35 pages of written questions. When we get into HUD and some of those agencies we send them volumes, so 35 pages isn't bad at all compared to what we do to HUD—what I would like to do to HUD. [Laughter.]

Thank you very much. We appreciate your attendance here today.

Mr. GIUFFRIDA. Thank you, Mr. Chairman, gentlemen.

[The following questions were not asked at the hearing but were submitted to the Agency for response for the record:]

QUESTIONS SUBMITTED BY SENATOR GARN

RESEARCH

Question: In developing a multi-hazards research program, how is FEMA providing for an objective internal assessment of its current program and future research requirements?

Answer: FEMA's internal assessment of its current program and future requirements for multi-hazard research involves several activities. State-of-the-art research assessments initiated during FY 1984 in the context of the Integrated Emergency Management System (IEMS) will focus first on common functions of emergency management for multiple hazards. These assessments will give priority to functions which program managers determine to be most in need of improvement, and those which require closest attention in adopting a multi-hazard approach to capability development. Second, as a result of FEMA's FY 1984 Research and Development reassessment study, conducted internally, a strengthened management process for determining research and development needs and priorities is being established. This process will involve all program offices, Regional Offices, and selected state and local emergency managers as well as research managers. FEMA will evaluate common function capabilities to determine operational similarities and differences as they are applied to diverse hazards, and will identify needs for further research and development to assure that such capabilities can be applied effectively to different emergency situations. These activities will focus on research and development projects that can provide near term results to strengthen basic emergency management system capabilities under IEMS. However, problems requiring longer lead times for R&D will also be identified.

Question: Are there any plans to obtain comments from outside the Agency about the proposed content and direction of its future research?

Answer: Among the specific means for achieving comments from outside the Agency will be review by the FEMA Advisory Board (composed of prestigious experts who provide advice to the Director of FEMA); a requirement for a systematic needs determination process for each Directorate involving field input; increased involvement of outside experts in proposal review; establishing a mechanism for coordinating emergency related research planning with other Federal agencies; and the development of state-of-the-art assessments by outside organizations which will identify research that has been performed in high priority program areas over past years, and which will specify additional knowledge that is needed, proposing approaches and resource requirements. All of these techniques in combination are expected to result in substantial broadening of comments from a range of sources on the content and direction of FEMA's research and development activities.

Question: How will you determine the balance between civil defense and non-civil defense research in the outyears?

Answer: FEMA will determine the balance between R&D requirements for the outyears using two principle criteria: (1) ongoing assessment of capabilities against the standards that must be met to assure preparedness in each area, and (2) unknowns that must be answered by R&D activities to provide the scientific and technical basis for meeting the special requirements posed by specific hazards.

Question: How was this done this year?

Answer: This year's balance was accomplished on the basis of research and program management assessment of the priority needs for supporting the development of each of the common functions required for an effective emergency management system capable of dealing with all hazards. As a guide to this assessment, the agency used past research that identified the extent of commonality of functions. As data and information on similarities and differences in operational applications is obtained, the balance of R&D needs will be reassessed within the context of the newly established needs assessment and research planning process.

It is anticipated that efforts to achieve balance across the full range of individual hazards will be greatly facilitated by the implementation of the recommendations for an improved research and development process, resulting from the FY 1984 reassessment of the R&D function in FEMA. The improvements which will be accomplished should result in more effective top management control, more complete needs determination processes, and better utilization of research outputs, as well as better overall balance in the Agency's research and development activities.

COMPREHENSIVE EMERGENCY PREPAREDNESS PLANNING

Question: Funding for FY 85 is proposed to prepare State and localities to respond to emergencies involving earthquakes, hurricanes, hazardous materials, dam safety and hazard mitigation assistance.

Notable changes from FY 84 include an increase of $2 million in the area of earthquakes, and a reduction of $450,000 in the area of hurricanes, and a $400,000 reduction in the area of dam safety? Would you please indicate why there are these fairly dramatic changes proposed for FY 85?

Answer: The $2 million increase requested for the Earthquake program is a recognition by FEMA that more resources must be expended to adequately prepare the nation for the consequences of catastrophic earthquakes. This recognition has its basis in the Congressionally mandated 5-Year Program Plan for the National Earthquake Hazards Reduction Program which FEMA, after consultation with an independent panel of experts, is presently finalizing and committed to submit to the Congress this summer.

The decrease of $450,000 in the Hurricane program reflects FEMA's intention to begin to integrate hurricane preparedness activities into the emergency preparedness infrastructure that presently exists within State and local government, elements of which receive funding from other FEMA programs.

Non-Federal dam safety is inherently a State responsibility. Therefore, by reducing the dam safety program by $400,000, FEMA is emphasizing the need for States to assume their appropriate role in funding dam safety programs.

Question: How do you determine planning priorities within the Integrated Emergency Management System?

Answer: State and local officials provide the first input into priority determination by (1) identifying the hazards and magnitude of risk in their jurisdictions; (2) assessing their current and required capabilities to confront those hazards; and (3) establishing realistic/multi-year plans to close the gap between existing and required capability. FEMA has provided guidance in each of these areas to ensure that this process is conducted in a logical, consistent manner nantionwide.

Funds appropriated under CEPP are, for the most part, earmarked for specific hazards; e.g., earthquake, hurricane, dam safety. Jurisdictions having the most at risk (people and property) from these hazards are given first priority. Allocation of funds is then tempered by the degree to which planning and response capabilities are lacking in the jurisdictions and the willingness of the jurisdictions to take corrective actions as shown in their multi-year development plans. A concerted effort is made in every case to broaden the application of these hazard-specific funds to projects that will meet, at least in part, the preparedness planning requirements of other hazards.

PROPOSED NETC WESTERN CAMPUS

After reviewing 29 sites, FEMA has selected the site of the Stewart Indian School in Carson City, Nevada as the optimum location for a western campus for the National Emergency Training Center.

Your FY 85 budget justification indicates $3,165,000 is for NETC West.

I understand that the budget justification in relation to NETC West was preliminary and does not reflect the major rehabilitation and construction costs.

Question: Would you please provide a more realistic cost breakout for FY 85 and the out-years for NETC West?

Answer: The initial costs for the acquisition and renovation include:

- Major building and site rehabilitation and construction	$10,775,986*
- Facility operations	1,620,051
- Facility & administrative supplies & equipment	1,345,500
- Student stipends	769,862
- Personnel	1,088,200
	$15,599,599

* This estimate includes the cost of all rehabilitation and construction within one budget year. Costs are based on engineering studies performed for the State of Nevada. The proposed shared occupancy by the community would reduce this cost projection. A site rehabilitation program is required that will include the upgrading of roads servicing the proposed campus area, the construction of a 200 space parking facility for students, and the building of new water supply, sewer, steam heat and irrigation systems will be built. Costs are based on previous engineering studies performed for the State of Nevada and have been adjusted for inflation.

It is estimated that, in the outyears, the annual budget for the campus will be $4,335,862. This figure must be adjusted each year to reflect the impact of inflation.

Question: Would you please describe the schedule highlights for the activation and operation of NETC West?

NETC WEST PROPOSED ACTIVATION

Answer: The following are the highlights for the activation and operation of NETC West for approving of the necessary funding by the Congress:

- Negotiations will need to be conducted with GSA and the State of Nevada to finalize leasing arrangements and services to be provided under the lease.
- Staff will need to be temporarily assigned from the Emmitsburg facility until the small permanent staff can be acquired.
- Contracts will need to be executed for the operation of the facility, the necessary maintenance and renovation, and the delivery of instructional programs.
- A course schedule will need to be finalized and distributed. It is planned to offer 70 course offerings to an estimated 2,200 resident students. A minimal schedule is planned for the first year.

Question: Why are you considering a ten year lease rather than a 99 year lease or the purchase of the former Government facility?

Answer: The consideration of a ten year lease has been used for discussion and comparison purposes. A longer term lease such as 99 years or the purchase could be considered in the negotiations with GSA and the State of Nevada.

Question: Why should the Federal Government improve the roads and rehabilitate the buildings at an expense of over $10 million for a facility that it does not own?

Answer: The Federal Government should improve the roads and rehabilitate the buildings for the following reasons:

- Improving and rehabilitating an existing facility is more cost beneficial than constructing a new facility.
- The Federal Government would be paying for the improvements and rehabilitation directly by having it done or indirectly through a higher lease cost.

Question: Have you talked to GSA about the negotiation of a lease for this facility?

Answer: No formal discussions have been conducted.

APPEALS OF FLOOD MAPS

Question: Flood Hazard Boundary Maps and Flood Insurance Rate Maps are subject to appeal by local officials and citizens. Last year, you indicated that during FY 84 you will be evaluating 277 official appeals. What is your current estimate for FY 84?

Answer: It is estimated that a total of 425 community appeals will be processed during 1984. This includes 25 Part 67 (44 CFR Part 67) appeals, which are appeals made during the 90-day appeals period allowed before the adoption of a new detailed flood insurance rate map. It also includes 400 Part 65 appeals, which communities file when they wish to have an effective map revised, usually as a result of changed floodplain conditions.

In addition, FEMA expects to process 1,000 individual appeals for letters of map amendment (LOMA), which amend rates charged or eliminate the insurance purchase requirement by removing individual structures from the identified Special Flood Hazard Area upon presentation of survey data demonstrating higher structure elevations than flood elevations identified on the flood insurance maps.

Question: How many appeals do you anticipate in FY 85 and how much have you budgeted for appeals?

Answer: For 1985, FEMA anticipates the number of appeals will be equivalent to the 1984 current estimate of 25 Part 67, 400 Part 65, and 1,000 letters of map amendment. FEMA has budgeted $200,000 for Part 67 appeals, $2,000,000 for Part 65 appeals, and $500,000 for letters of map amendment.

MAP APPEAL TIMEFRAME

Question: What is the length of time a community has to appeal?

Answer: A community has 90 days from the time the final map is presented to submit an appeal. The map will then not become effective until six months after the appeal is resolved. If the community submits an appeal after the 90-day period closes, the new map will become effective following the 6-month compliance period as planned. However, if the appeal is found to be valid, the map will be changed after becoming effective.

If should be noted that the community is consulted at several times during the flood study process and is asked to review a preliminary copy of the flood study before the appeals period begins.

Question: What is the position of a community that wishes to appeal after it failed to respond at all during the designated time period?

Answer: A community may appeal after the 90-day appeal period. However, the map will become effective on the scheduled date, and altered if the appeal is found valid upon review by FEMA.

Question: How many communities have indicated to FEMA that they wished to appeal flood insurance rate maps after the appeals period had ended?

Answer: Less than 1% of the communities studied have appealed maps after the 90-day appeals period expired but before the map became effective.

FLOOD PLAIN MANAGEMENT

Question: The Flood Plain Management program is proposed for essentially the same level of funding in FY 85 and FY 84 except for Flood Studies and Surveys.

Flood Studies and Surveys which identify areas with a given probability of flooding is being reduced 25% or $12.4 million below the FY 84 appropriation.

The budget reduction is recommended to permit FEMA to reassess its flood study effort.

Would you please describe what you plan to accomplish in FY 85?

Answer: The following activities are planned for 1985 in the area of Flood Studies and Surveys:

- initiation of 24 detailed Flood Insurance Studies,
- initiation of 74 Flood Insurance Restudies,
- initiation of 325 existing data Flood Insurance Studies,
- initiation of 500 limited detail Flood Insurance Studies,
- completion of 622 Flood Insurance Studies through review and processing,
- evaluation of 400 official appeals of Flood Hazard Boundary Maps and Flood Insurance Rate Maps,
- establishment of eligibility of 150 communities to participate in the NFIP, Emergency Phase, and 1,500 communities to participate in the Regular Phase, as well as the continued monitoring of local flood plain management enforcement by all programm participants,
- provision of technical assistance to local officials and private property developers in applying the results of flood studies to their plans, and the handling of 1,000 requests for Letters of Map Amendment, and
- continued printing, distribution and storage of completed flood study data.

Question: What activities previously performed will be eliminated or performed at a reduced level?

Answer: New detailed studies will be performed at a reduced level in 1985. FEMA plans to initiate 24 new detailed studies, compared to 311 new detailed studies in 1984.

Question: What are the outyear implications in this area?

Answer: The study results which are due to the Congress in September, 1984, will determine FEMA's ability to quickly convert the remaining 7,000 Emergency Program communities. If a large number can be converted utilizing less time consuming or expensive techniques, the impact of the 1985 reductions in this area will have minimal effect on FEMA's ability to complete the conversions of the remaining communities.

Question: Would you please provide copies of the fund allocation table on Page FPM-11 and the status chart on Page FPM-12 of your budget justification for the record?

Answer: The following charts depict the funds allocation and status of flood studies, respectively.

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FUNDING ALLOCATION

	1983	1984	1985
	(Dollars in Thousands)		
Studies in Progress	$2,094	$2,565	$1,716
New Studies	14,014	22,658	11,250
Restudies	7,673	7,102	7,400
Technical Evaluation, Appeals and Map Revisions	19,166	14,600	13,933
Printing/Distribution	2,430	2,486	2,753
Special Studies	864	...	...
Engineering/Research Reports	...	341	300
Total Flood Studies and Surveys	46,241	49,752	37,352

Status of Detailed Risk Zone and Elevation Studies

	Actual 1983	Estimate 1984	Estimate 1985
New studies completed, beginning year	8,153	8,818	9,134
New studies initiated during year	435	411	849
Communities not in Regular Program (new detail studies)	(268)	(311)	(24)
Limited Detail Studies (these begin in FY 85)			(500)
Existing Data Studies	(167)	(100)	(325)
Additional areas within communities in the Regular Program (restudy updates)	73	91	74
Studies completed during year (appeals process started)	665	316	622
Studies completed at end of year (cumulative)	8,818	9,134	9,756
Communities with elevations in Regular Program at end of year	7,597	8,137	8,637
Communities without elevations in Regular Program at end of year	2,163	3,163	4,163
Total number of communities in Regular Program at end of year	9,760	11,300	12,800
Communities nonparticipating and suspended for non-compliance	132	130	125

TELECOMMUNICATIONS AND WARNING

Question: The FY 85 budget request contains the following request for FEMA Communications Systems:

- National Teletype System - $7 million
- National Voice System - $450,000
- National Radio System - $10 million
- Other communications services - $8 million

What would be the effect of funding the warning systems and not the communications systems in FY 85?

Answer: It is imperative to note that the FEMA communications and warning systems must be enhanced simultaneously. It is unreasonable to warn the populace and not be able to continue to exchange the essential functions via communications. These FEMA infrastructure systems are an integral part of the overall FEMA National Emergency Management Systems (NEMS) and are designed to support and provide warning and information to meet the full spectrum of FEMA's emergency management responsibilities. It is FEMA's aim to provide the most responsive, reliable communications and warning systems possible. Not funding the communications systems at the requested levels in FY 85 would have a dramatic impact on the service capability of the FEMA Headquarters and Regions. The communications systems are the programs where we find a proliferation of mid-50's vintage equipment which rely greatly on commercial leased circuitry and the invariable escalation in rate increases as well as no longer being supported from a maintenance standpoint by the original vendor. This increases our overall personnel costs, reduces operational capability and is a morale factor.

Question: What would this do to your planned scheduling sequence?

Answer: Most regional managers have been patiently waiting for new equipment and have been collaborating with state officials on the new services. Each year funding for badly needed modernization is considered for deferral. If the communications systems are not funded in FY 85 at the levels requested enhanced upgrade and modernization efforts will continue to spread out over a longer period of time. This appears acceptable from a programmatic aspect but is highly unrealistic from a system design, operations and economic perspective.

COMMUNICATIONS SYSTEMS

Question: What are the outyear implications for each of those systems?

Answer: It can be expected that additional costs will be incurred in the outyears to maintain pace with state-of-the-art equipment for our systems in addition to rate increases. The upgrade of the FEMA National Teletype system should be completed in FY 86. The FEMA National Voice System will be maintained at the present level. Upgrade of services and facilities for the FEMA National Radio system will continue through 1988 for all regions, states and territories. The other communications requirements should be completed in FY 86 with the installation of Electronic Private Automatic Branch Exchange switching systems in regions and selected locations.

EMERGENCY OPERATING CENTERS

Question: FEMA is requesting $16.3 million for Emergency Operating Centers in FY 85 which is a 54% increase over FY 84. The program consists of 50% Federal funding with a 50% cash match by the State or locality for the design, renovation or construction of an Emergency Operating Center which incorporates communications equipment, emerency power and other special features. Are there rigid specifications which have to be used in the design and construction of these facilities?

Answer: The Emergency Operating Center (EOC) program does not provide funding assistance for excavation or the basic structure on the EOC (shell). These funds are provided for modification to existing structures, such as interior partitions and other items needed to convert space for EOC use, or comparable work in a new building. FEMA specifications for funding are specific, though not deemed to be rigid. These specifications are flexible in that they address operational capabilities that can be achieved in different ways. In general, FEMA requires the following:

1. Radiation shielding with at least a 100 protection factor in areas not considered to be subject to great risk (engineering guidance is available);

2. A generator for emergency power sized to handle EOC demand load, with connected fuel supply;

3. Capability to recieve warning 24 hours a day;

4. Protection against the Electromagnetic Pulse (EMP) effects of a high altitude nuclear burst (technical guidance is available);

5. Communications capability to the broadcast media, next higher level authority, adjacent jurisdictions, primary operating forces, and other forces;

6. A properly sized operations room with equipment and displays to enable key government officials to conduct emergency activities (CPG 1-20 provides sample layouts);

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7. Mechanical ventilation designed to repel particulate substances, principally from nuclear fallout;

8. Interior lighting with adequate illumination for emergency environment;

9. Water closets, lavatories and showers in accordance with local building codes; and

10. Reliable 14-day water supply not dependent upon commerical power.

Question: Have the specifications been tested to validate the performance of the facility?

EMERGENCY OPERATING CENTERS

ANSWER: Yes. FEMA requires that a drill of the EOC's operational capability be conducted before the final 10 percent FEMA matching funds payment is made. The purpose of this drill is to test the physical facilities and operational capability of the EOC.

QUESTION: Have the specifications been reviewed, via value engineering, to determine if the facilities are being designed (as required)?

ANSWER: Yes. All specifications and plans are reviewed by State and FEMA Region engineers (must be FEMA trained and FSA certified) in relation to cost, value, and conformance with FEMA standards.

QUESTION: How many State and local emergency operating centers now meet FEMA design requirements?

ANSWER: At the end of FY 1983, it is estimated that five States and 168 local EOCs met all FEMA minimum standards, (for funding). If the term "design requirements" means physical facility in which EOC is housed, then considerably more meet this requirement, but may be lacking in communication, etc.

QUESTION: What is the cost of a FEMA designed emergency operating center compared to those generally in use today?

ANSWER: EOCs supported before 1980 were funded on a piecemeal basis to achieve varying capabilities. In many instances they are still operationally incapable of functioning in a major emergency or have deteriorated. This practice was changed by FEMA policy in FY 1982, which now mandates that all EOCs funded must meet a minimum set of criteria. Each EOC must meet the unique requirements of the State or local government it serves (size, complexity, etc.). Similarly, not all EOC's require the same degree of upgrading to correct deficiencies. Therefore, the cost varies significantly among applicants. On average, FEMA is contributing approximately $200,000 Federal share per EOC applicant.

QUESTION: How are State and local governments chosen for participation in this program?

ANSWER: States prepare an EOC Program Development Plan, as part of a multiyear development plan, which sets forth EOC requirements and State priorities for funding. These priorities are based on all-hazard vulnerability assessments and State management determination. The FEMA Region, based on State priorities, affixes a Regional priority for funding, and obligates funds accordingly.

QUESTION: What is the total number that have built or renovated facilities?

ANSWER: A total of 167 States or State Areas, and 3,139 localities have facilities which they call EOC. Most do not meet FEMA standards. Our criteria does not distinquish cost allowed for new construction verses modifications and in fact equates such allowable costs. Therefore, FEMA does not keep records or numbers modified verses EOC incorporated in new facilities.

QUESTION: What is the current estimate of the numbers of EOC's required nationwide?

ANSWER: The present estimate is approximately 5,000. This projection is being studied by FEMA, and some revision is anticipated by the fourth quarter of FY 1984.

QUESTION: What would the cost of such a system be in current dollars.

ANSWER: The estimated cost projection exceeds $300 million. However, present ongoing study should provide a better estimate by the fourth quarter of FY 1984.

STATE AND LOCAL WARNING AND CONTROL

Question: The budget justification contains a $5.9 million request for State and Local Warning and Communications Systems which is 118% over the FY 84 appropriation. These are 50/50 matching funds available to State and local governments. What criteria is used in making decisions about the jurisdictions that will be funded?

Answer: The State and Local Warning and Communications Systems program is comprised of various sub-systems for the purchase and installation of State and local government direction and control, alerting, warning and communications equipment up to a 50 percent matching Federal funds basis. The criteria used in making decisions on which jurisdictions will be funded is discussed for each sub-system in Chapter 4 of CPG 1-3, Federal Assistance Handbook: Emergency Management, Direction and Control Programs.

By order of priority, they are:

1. Operation SECURE.
2. RACES.
3. Conversion of warning systems to radio activated systems.
4. State-wide communication systems upgrading and protection for survivability.
5. State warning systems.
6. Other local warning systems.
7. Local communications (other than that funded under EOC program).

FEMA funds are allocated based on the above priorities. States reflect their applicant requirements to Regions according to these priorities. The State determinss which applicant has priority over another within each of these catagories.

Question: For example, what weight is given to the population at risk to various hazards in making funding decisions?

Answer: As stated above, the State must determine which jurisdictions have priority for funds available. The States manage the hazard vulnerability assessments done by localities based on FEMA guidance (CPG 1-101 and CPG 1-102). This guidance considers population and relative risk.

STATE AND LOCAL WARNING AND COMMUNICATIONS

QUESTION: Are there funding options, such as change in the Federal/State funding shares, that could be used to decrease the "shortfall" and increase the Federal funding coverage?

ANSWER: The law prescribes "not to exceed 50 percent." Under OMB guidance, FEMA does permit the applicant to apply "in-kind" cost. Therefore, the shortfall is decreased by additional Federal funding.

QUESTION: Would you please provide, for the record, specific information about the projects, locations and equipment that require increased funding?

ANSWER: The following chart provides comparative costs for the subelements under this program element. Specific projects can be furnished at a future date:

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Project Description	FY 84		FY 85	
	Qty.	Cost ($000)	Qty.	Cost ($000)
Operation SECURE	10	110	15	862
VHF, UHF & Microwave radio systems	10	642	15	1,455
Back-up radio - RACES	10	100	15	150
Low frequency radio warning, tone alert warning	10	150	15	225
Outdoor and indoor radio controlled public warning	300	1,400	300	2,908
Radio receivers & transmitters for local gov't emergency mgt officials and local forces	300	300	300	300
Technical and operational guidance by FEMA Regional and Hdq personnel to State and local jurisdictions.	56	-0-	56	-0-
Total Program Funds		2,702		5,900
(Dollars in Thousands)				

FACILITY SURVEY

Question: The National Shelter Surveys have been conducted under the Population Protection Program and are proposed to expand in FY 85. The program would be expanded to identify facilities to protect people from natural and technological hazards which may affect local jurisdictions.

The budget request is up 121% over the FY 84 appropriations to $9,500,000. How many facility surveys have been conducted to date under the shelter program?

Answer: Through February 1984, we have surveyed 1,260,741 facilities in host areas to determine the characteristics, physical capacity and adaptability to provide protective shelter, emergency lodging, reception and care. Additionally, 348,726 facilities have been surveyed in risk areas for fallout protection.

Question: Why have the program costs doubled since last year?

Answer: The funds requested are to involve all interested States in management and conduct of the surveys. The requested funds are to begin the initial year of a 5-year cycle to complete the multi-hazard surveys nationwide. These surveys will build upon the existing shelter data base. FEMA's decision of involving States and some private sector firms in conduct of surveys is acknowledged to be a more expensive approach, however, it is offset by providing increased involvement of the States in performance of the work, thus, decentralizing program management to the States.

As new States and State personnel are brought into this effort, there is time devoted to special orientation and technical training and to establishing their management processes to do the surveys. These start up activities are funded, but do not generate outputs.

Question: Would you please describe your objective and timetable for FY 85 and beyond?

Answer: The objective is to broaden the present survey procedures to encompass the requirements for the development of generic population protection plans for all hazards.

FEMA will be working toward a 5-year plan for completion of the multi-hazard surveys nationwide through FY 89 by building upon the existing shelter facility surveys through the CCA process with continued utilization of the private sector. In addition, this survey activity will be supplemented by 50 FTE of college student effort supervised by the FEMA Region in-house staff.

FEMA's intention is to implement an enhanced population protection effort beginning in 1985 and broadening the emphasis to a program of incorporating elements common to multi-hazards into an integrated comprehensive planning effort. The facility surveys provide data necessary to support this planning effort.

PROTECTION OF INDUSTRIAL CAPABILITY

Question: I note from the full opening statement submitted, that the request for Protection of Industrial Capability is $5,566,000 - an 18% increase over last year's appropriation.

The program is being broadened to protect our industrial capability against a full range of material and other hazards beyond the focus of enemy attack.

Last year, I asked you about GAO's estimate that the costs for the more limited program then envisioned might approach $8 billion.

You responded that by the end of last year, after doing some detail planning, you would be able to address that question. What is the present long-term cost estimate for Protection of Industrial Capability activities?

Answer: In the late summer of 1983, it became evident that more time would be required to complete the studies and analyses mandated by the controlling National Security Decision Directive. Approval was obtained from the President's National Security

Advisor to extend the study activity period. The studies and analyses needed to develop the basic information which will be used to develop a series of program options for the President are still underway, and long-term cost estimates are not yet available. The options being developed for the Presdient will describe possible strategies and will set forth cost estimates for addressing needs for protection of essential industries and their workers against all forms of hazards -- natural, technological and national security-related. The projection of future costs will not be possible until the studies and analyses are completed and the President has made his choice of the programmatic approach to be employed.

POPULATION PROTECTION

Question: You are under the Integrated Emergency Management System broadening Crisis Relocation or evacuation planning to one of developing local plans to protect the population from all types of hazards. To this end, you have requested an 83% increase in the number of State planners and a 52% increase in the funding to $13,200,000.

Would you explain how much of the program still involves the evacuation or relocation of a threatened population?

Answer: There are only two basic options available to protect citizens and save lives in the event of any disaster situation (natural disaster, technological accident, or nuclear attack). One is to protect people in-place in their homes or in nearby collective shelters. The other involves evacuation of people to reception centers located outside of the hazard area and to provide shelter and care for them there. The IEMS approach to emergency management emphasizes the use of evacuation plans to protect people but also recognizes the need to plan for in-place protection using the best available facilities, if time or circumstances preclude evacuation. The combination of evacuation and in-place protection planning will provide each jurisdiction the flexibility, when a particular hazard/disaster is occurring or is expected, to select the best options to increase the survival potential of its citizens.

Question: What are the most likely threats that require population protection?

Answer: The spectrum of hazards from which the people require protection during a disaster or emergency situation is vast. However, the following list represents the most likely types of hazards that pose a threat to life and property: flood, fire, hurricane, tornado, earthquake, hazardous chemical/radiological material spills or releases, and nuclear attack.

Question: Last year you testified that in FY 1982, 37 percent of the jurisdictions requiring Crisis Relocation Plans had them. How has this percentage changed in the last year?

Answer: By the end of FY 1983, we had completed a total of 1,480 of the 3,135 Crisis Relocation Plans required. This represented a 10 percent increase over FY 1982. However, FY 1984 represents the start of the population protection planning program, which embraces all-hazards planning. Therefore, Crisis Relocation Plans developed solely for nuclear attack are no longer being produced. However, the applicable planning data contained in each published Crisis Relocation Plan will be incorporated into the jurisdiction's Population Protection Plan.

Question: You also indicated tests and exercises of such plans are essential. What have you done along these lines since we last met?

Answer: Exercises provide local jurisdictions a means to evaluate response procedures and validate government emergency management organization's capabilities to respond to disaster situations. Therefore, starting in FY 1984 an exercise will be conducted for each Population Protection Plan developed. Guidance and training programs have also been implemented.

RADIOLOGICAL DEFENSE OFFICERS (RDOs)

Question: We are interested in the type of expertise required by an individual who wishes to become a State Radiological Defense Officer. Would you please provide, for the record, a percent distribution by type of educational degree for those on-board as State Radiological Defense Officers?

Answer: The State reports the hiring of a State RDO under the CCA to the Regional Office and includes identification of the personnel hired, starting dates, their respective qualifications, and their resumes. Currently 50 of the 52 States (including the District of Columbia and Puerto Rico) have a State Radiological Defense Officer. Connecticut and Pennsylvania do not have an RDO at this time. The distribution by educational degree is as follows:

Doctoral Degree	1	(2%)
Masters Degree	11	(22%)
Bachelors Degree	28	(56%)
Associate Degree	2	(4%)
No formal Degree	8	(16%)
Total	50	(100%)

Those RDOs that do not have a formal educational degree all have some college and/or training in military schools together with experience that qualifies them for the position.

Question: Why are you proposing an additional 51 Assistants to these RDO's?

Answer: The FY 1985 budget submission provides for continuation of the 52 fully funded State RDO's--one for each State, the District of Columbia, and Puerto Rico. In addition, funding has been requested to provide for an additional 51 Assistant State RDO's. The Assistant State RDO will assist the local jurisdictions in the accelerated development of the radiological annex and the radiological defense system in consonance with the emergency operations planning activities.

RDO's are the key factor in developing radiological defense systems at the local level. At the current level of staffing (one RDO per State), it will require some 12 more years to complete the initial cycle of local plans. By this time, the plans first completed (in 1982-1984) will be grossly out-of-date.

The additional 51 Assistant State RDOs are required to assist the local jurisdictions in the accelerated development of the radiological annex and the radiological defense system in consonance with emergency operations planning activities and to enhance State and local government planning and response capabilities for all radiological emergencies.

As part of the Integrated Emergency Management System, existing nuclear radiological defense systems will be expanded to include all radiological hazards determined to be a threat to the jurisdiction.

Question: What are the costs associated with those additional personnel?

Answer: The costs are estimated as follows for FY 85:

52 State RDOs (12 months)...............	$3,000,000
51 Assistant State RDOs (6 months)......	1,300,000
	4,300,000

The FY 85 budget calls for 51 Assistant RDOs on-board for the 3rd and 4th quarters, as it is assumed to take at least two quarters to hire a qualified Assistant State RDO.

Question: What type of background and skills will these persons be required to possess?

Answer: Personnel hired as State and Assistant State RDO's shall meet, as a minimum, the position qualification standards provided by FEMA or approved by the Regional Office. The State RDO position description qualification standard may also be used for the Assistant State RDO, if appropriate, and if approved by the State and the Regional Office.

The requirements for a RDO should encompass the following:

- A full four-year or longer curriculum in an accredited college or university that satisfies the requirements for a bachelor's or higher degree in a field of health physics, physical science, biological science, or engineering. The curriculum must have included at least 30 semester hours in health physics, engineering, radiological science, chemistry, physics, biology and/or mathematics for the purpose of providing an understanding of the principles of health physics; or

- Four years of progressive technical experience and/or education that provided an understanding of sciences applicable to the field of health physics comparable to that which would have been acquired through successful completion of a full four-year college course as described above. This education and/or experience msut have included or been supplemented by:

- Courses totaling 30 semester hours as specified in paragraph above; or

- Certification as a health physicist by the American Board of Health Physics.

In addition, the RDO must have knowledge of the civil defense program at the Federal, State and local level.

RDOs that meet the basic entrance requirments are provided additional training in the duties and functions of a RDO and in plan development through training offered by FEMA. The State also provides orientation and on-the-job training to familiarize the RDO with the State civil defense program and elements unique to that State's operations. As with any professional position, knowledge and skills development is a continuing effort.

RADIOLOGICAL EMERGENCY PREPAREDNESS

Question: In order to be reasonably sure that the effect of a radiological emergency at a commercial nuclear power plant could be handled safely and efficiently State and local emergency and preparedness plans are reviewed by FEMA with assistance from several other Federal agencies. A full scale exercise of these plans involving the utility, State and local agencies has been required once a year with FEMA evaluating the exercise.

A proposal is underway to change these exercises to less than once a year.

What is FEMA's view toward this reduction and the effect on radiological emergency preparedness?

Answer: FEMA strongly supports the biennial full-participation (full-scale) radiological emergency preparedness (REP) exercise frequency for State and local governments around commercial nuclear power plants. After a lengthy period of review and analysis of this issue which included comments via the "Federal Register" regulatory process, FEMA published its final rule in the "Federal Register" on September 28, 1983, adopting the biennial REP exercise frequency. FEMA's decision to adopt the biennial full-participation exercise frequency for State and local governments was based on the following: (1) of the 54 operating commercial nuclear power plants, almost all of them have held full-participation exercises with the affected State and local governments; and (2) the additional time between full-participation exercises allows better preparation of exercise objectives and scenarios for the conduct of more comprehensive offsite exercises. Also, this additional time can be devoted to correcting and improving identified deficiencies and/or weaknesses from previous exercises including efforts on a remedial exercise, if necessary.

While we advocate biennial exercises as a national standard, we have retained the authority to require more frequent "remedial" exercises should our reviews of offsite measures for public safety indicate significant deficiencies. Additionally, changes to the federally

Required exercises have recognized the [illegible] of the State and local governments to elect a more frequent exercise pattern. The overall effect of the biennial frequency should be enhanced State and local capabilities to assure public safety in jurisdictions affected by nuclear power facilities. The majority of respondents to the FEMA proposed rule change, especially State and local governments and the utilities, strongly supported a biennial frequency.

Question: One of the areas addressed in FY 83 and FY 84 has been transportation accidents of radioactive and non-radioactive hazardous substances. Although $100,000 was allocated to this activity in each of the two previous fiscal years, no funds are provided in FY 85.

Your budget justification (REP-8) indicates that FEMA is involved in assisting State and local governments in developing and exercising preparedness and response plans; reviews the plans and exercises; and conducts planning and exercise workshops. No funding has been provided in FY 85.

Answer: For FY 85, activities in support of the program have been transferred from REP to Comprehensive Emergency Preparedness Planning (CEPP) and are incorporated under the Hazardous Materials program. The answer to the three questions raised is reflected, therefore, in the justification provided in CEPP for Hazardous Materials (Section CEP-20). This includes an expansion of the guidance already developed for transportation accidents involving radioactive materials to include other hazardous materials transportation emergencies. The conduct of workshops is included within the generic program activity of "providing technical assistance to State and local governments."

Question: How many FTE will be involved in this effort in FY 85?

Answer: The FTE for this activity is reflected in the FY 85 work year estimate of 13 for hazardous materials.

Question: Where will the funds to conduct workshops come from?

Answer: The funds to conduct the workshops will come from the $250,000 requested for hazardous materials in FY 85.

Question: What effort and funding is anticipated for the outyears?

Answer: A funding level commensurate with the FY 85 level ($250,000) is anticipated for the outyears.

FEMA's activity in this program area is continuing in full recognition of the day-to-day vulnerability experienced by State and particularly local jurisdictions created by the routine transportation of hazardous substances. In addition to the dedicated resources identified above, FEMA's implementation of the Integrated Emergency Management System program includes components that respond to the difficulties of managing intergovernmental/interagency response that have typified such transportation emergencies.

DOSIMETERS

Question: I see that for FY 85, you are planning both pilot production and the initiation of contract mass production of dosimeters. I know that you have identified the Navy and State and Local Civil Defense Officals as two groups who will have use for the dosimeters. What studies have you done to establish who the groups requiring these instruments are and to quantify the production requirements for such instruments?

Answer: Over the years we have conducted a number of studies to identify groups needing dosimeters. The most notable are two Oak Ridge National Laboratory (ORNL) reports concerned with the overriding need for instruments by citizens in shelters when radiation levels could be dangerously high. Copies of the reports by ORNL are available. FEMA also has a RADEF Referrent Group (a task force comprised of experts in radiological defense operations from Federal, State, and local organizations) report which speaks to this question and is available. An internal FEMA staff paper dated January 11, 1984, "Procurement of Dosimeters" details the requirements versus range and application and is available.

Question: What have these studies indicated? Would you please provide a copy of the information to the Subcommittee.

Answer: These studies have indicated that instruments are needed not only for shelters but also for postattack recovery operations by citizens, emergency services, vital facilities, essential industry, etc. There is also a need for low range instruments that can be used in training where live radioactive sources are used to provide the necessary realism. The current inventory is inadequate to meet total requirements. A copy of all four documents are being made available to the committee.

Question: What analysis have you performed as to the amount that the users might pay for the dosimeters? It has been my observation that there is an unlimited population that will take something when there is no cost.

Answer: In all cases instruments will be granted to the States in accordance with Public Law 81-920, the Federal Civil Defense Act of 1950, as amended. Section 201, paragraph h, authorized the Administration "to procure and maintain, under this subsection, radiological instruments and detection devices, protection masks and gas detection kits, and distribute the same by loan or grant to the States for civil defense purposes --------." Consistent with the law, it is our plan to procure instruments for use by emergency services in public shelter and for postattack recovery operations.

Question: If the user would have to pay 25% or 50% of the cost of the dosimeter, what would be your estimate of the effect on your projected demand for the instruments?

Answer: We believe that when mass production is achieved by two or more manufacturers dosimeters and chargers will be available at reasonable cost to the public at large, who wish to buy their own instruments. We believe the Federal government obligation is to meet the major national requirement for instruments. This will not preclude citizens from procuring their own from private suppliers, and there would be some interest to do that, but not nearly enough for us to expect adequate preparedness for this nation and all of its citizens.

PRODUCTION OF DOSIMETER

Question: Under the instrumentation category within radiological defense, you plan a 113% increase over last year to the level of $15,550,000. This is about 75% of the entire budget authority requested for radiological defense. The instrumentation category which was the topic of some discussion during last year's hearing, provided for devices to measure radiation that includes high and low range dosimeters. How many of each type of dosimeter will have been produced under the pilot production program at Rolla, North Dakota through the end of FY 84 and how much will this cost?

Answer: It is expected that, by the end of FY 1984, only a few thousand low range dosimeters will have been pilot produced. These quantities are subject to problems being encountered in proving out the precision tooling necessary for these instruments. These problems are expected and their solution is the key to low cost mass production by the private sector. These scale up problems are the reason for a tightly controlled pilot production phase. The cost of the Rolla operation for 1984 will be about $1 million.

Question: For FY 85, how many high range and low range dosimeters do you anticipate producing at the Rolla Facility and what is the cost associated with the production of each?

Answer: For FY 1985 only the amount of instruments required to prove out the design will be pilot produced. This is not expected to exceed 10,000 completed instruments of any given range. Of these about 1,000 of each range will be given to the Army and Navy for qualification testing. About 100 will go to NASA for the space shuttle. The remainder will be tested by the FEMA Test Facility, contractors' laboratories, and in the field with a view toward assuring their long term reliability (20 years or more shelf life under adverse conditions).

The estimated costs associated with pilot production at Rolla for FY 1985 is $1.5 million total, which addresses both high and low range instruments.

Question: You anticipate contracts for private sector mass production of dosimeters in FY 85. How much money is budgeted for production of each dosimeter type?

Answer: We have estimated a requirement for $3,650,000 for startup mass production of low range dosimeters; another $1,000,000 is budgeted for charger procurement. We estimate that only the 200 mR low range dosimeter will be produced by the private sector in FY 1985. This range will serve to fill needs for dosimeters for training.

PRODUCTION OF DOSIMETER

Question: What is the anticipated size of the production for FY 85?

Answer: For planning purposes, we are estimating about 100,000 dosimeters will be produced by the private sector in FY 85.

Question: Would you please identify the user groups who are the anticipated recipients of the dosimeter production? Please indicate how many of each type of dosimeter you anticipate each group would receive.

Answer: The user groups are:

- Low range: Training programs for all types of radiological emergencies. Most training will be designed by FEMA and conducted by States for State and local users.

- Intermediate range: Post-attack recovery operations, emergency workers involved in nuclear power plant accidents, emergency services, vital facilities, essential industry.

- High range: Same as for Intermediate Range, plus citizens in fallout shelters.

Our best estimates at this time evidence a requirement for the following:

- Training - 350,000 (200 mR dosimeters)

- Post-attack recovery - many millions (intermediate and high range)

- Emergency services - hundreds of thousands (intermediate and high range)

- Vital facilities - hundreds of thousands (intermediate and high range)

- Essential industry - hundreds of thousands (intermediate and high range)

- Shelters - many millions (intermediate and high range)

A current study to be concluded by the end of FY 84 will provide specific numeric estimates for the intermediate and high range instruments.

INSTRUMENTATION COST

Question: Would you please provide a table for the record breaking down the $15,550,000 instrumentation cost of the budget justification into each of the activities described in the budget justification including:

Senator Garn—Continued

- o Equipment maintenance and calibration
- o Pilot production dosimeters
- o Mass production dosimeters
- o Relocation and operation of the Emergency Management Systems Test Facility
- o Ratemeter.

Answer: FY 1985 - Radiological Instrumentation

Equipment Engineering	$ 3,000,000
Test Facility Basic Operating Cost	150,000
Move of Emergency Management Systems Test Facility	750,000
Rolla Support - ORNL	500,000
Inventory Support	200,000
Low Cost Ratemeter Development	400,000
Detector Development	100,000
Radiochromic Dye Dosimeter Development	300,000
IEMS Survey Meter	200,000
Adv. Instrumentation Concepts	50,000
Maintenance of Calibration Standards/ National Bureau of Standards (NBS)	20,000
Directional Survey Meter Development	130,000
Training Instrumentation	100,000
Carbon Fiber Technology Development	100,000
Equipment Procurement	$ 6,350,000
Rolla	1,500,000
Charger Pilot Production	1,000,000
Dosimeter Mass Production Startup	3,650,000
Repair Parts/Batteries	200,000
Equipment Logistics Support	$ 500,000
Equipment Maintenance and Calibration	$ 5,700,000
FY 1985 Total:	$ 15,550,000

Question: Would you please provide a listing for the record of the anticipated instrumentation costs from FY 86 to FY 88 similar to that provided in Budget Justification, page CD-41?

Answer:

	Fiscal Year (Thousands)		
	1986	1987	1988
Equipment Engineering........	$3,000	$3,000	$3,000
Equipment Procurement........	16,000	19,200	23,500
Equipment Logistics Support..	500	600	700
Equipment Maintenance and Calibration...............	6,285	7,285	7,585
TOTAL.................	25,785	30,085	34,785

NOTE: The projected levels shown for equipment procurement may have to be reduced in favor of maintenance and calibration once we have a better definition of costs associated with the receipt and distribution of new instruments.

EMERGENCY MANAGEMENT INSTRUCTION

The Federal Emergency Management Agency has tested a preliminary version of an instruction guide on Emergency Management for Kindergarten through 12th Grade.

Apparently you have pilot-tested course materials in 628 schools in 22 states.

Question: How much funding has been put into this course to date?

Answer: To date, $846,000 has been put into the K-12 program.

Question: How much funding in the FY 85 budget is there for Emergency Management training in the public schools?

Answer: No funding has been specifically identified in the FY 1985 budget for this item.

Question: How much funding do you estimate for this area in the out-years?

Answer: The funding level for the out-years for this program has not been determined as yet.

The primary thrust of the course deals with information on reaction to natural disasters, including hurricanes, earthquakes, floods and man-made hazards such as fire pollution and nuclear accidents.

Question: Would you please indicate how much of the course text relates to natural disasters, how much to man-made hazards, and how much, if any, to nuclear attack?

Answer: Approximately 30% of the course relates to man-made hazards including nuclear while the remaining 70% relates to natural disasters.

Question: What are your future plans for this course?

Answer: In May of 1984, a national review panel will be convened to review the K-12 program. The recommendations of this panel will be used to make the decisions related to the future of this program and determine the necessary funding levels for FY 1985 and beyond.

TRAINING AND FIRE PROGRAMS

Approximately $25 million is requested in FY 85 for the development of training materials and the conduct of training courses. Each of the three major areas within Training and Fire Programs in FY 85 request is increased about $2.5 million over the FY 84 appropriation.

This increase for the Emergency Management Institute is 135% over the FY 84 level.

Question: Why was the Resident Program included in Civil Defense and not specifically identified in prior year budget submissions?

Answer: Prior to 1981, the Emergency Management Institute existed in Battle Creek, Michigan, as the Defense Civil Preparedness Agency Staff College. With the creation of the Federal Emergency Management Agency, the institution was relocated to Emmitsburg, Maryland, to utilize an existing Agency facility and the name was changed to the Emergency Management Institute. Although the Emergency Management Institute's curriculum is largely Civil Defense oriented, there are some non-Civil Defense oriented courses in the areas of floodplain management, disaster preparedness, and civil preparedness. Based on past experience, however, the budget for the EMI resident program as well as most of the field program continued to be submitted under the Civil Defense funding area through FY 1984. In order to correct this deficiency and identify funding requirements for the various operating centers within the Training and Fire Program, a request was made to have a separate line item established in the FY 1985 budget structure for the non-Civil Defense funded portion of the EMI resident program. Such a line item was established and the necessary funding requirements were indicated.

Your justification on Page TFP-18 states that the growth of the Resident Program element is "constrained by the limitations of the facility". "Plans are being developed to increase the campus capacity" in the out-years.

Question: Would you please describe what is being planned, the location(s) for which it is being planned, and provide an estimate of these future costs?

Answer: In order to meet the increasing demands for attendance at National Fire Academy and Emergency Management Institute resident courses, a number of options are being considered. These include:

- Creation of a western campus extension of the Emmitsburg campus. This option would permit the attendance of 1,100 additiona students at each institution. The estimated annual operating budget for the western extension is $4,335,862.

- Delivery of resident courses in the field. This is currently being done with the Emergency Management Course, the Intergovernmental Relations Seminar, and the Formulating Public Policy Course. That may be expanded to include other resident courses as funds and staff become available.

EMI RESIDENT TRAINING PROGRAMS

The Emergency Management Institute Program includes for the first time a request for Resident Training Programs. According to the justification, the Resident Programs were included in earlier budgets but not broken out specifically. These programs are projected to cost $1.49 million during FY 85, and involve a wide variety of non-civil defense emergency management activities.

Question: Would you please provide a similar breakout of the anticipated funding and course titles for FY 85?

Answer: The requested dollars to fund Non-CD Resident Programs are: $1,490,000.

The projected Non-CD Resident Courses in FY 1985 are:

Emergency Medical Services Management in Disasters and Mass Casualty Incidents
Emergency Operations Planning Course-Pilot
Radiological Emergency Response Operations (Nevada)
Earthquake Hazard Awareness for Utility Lifeline Systems
Individual and Family Grant Workshop
Federal Coordinating Officer (FCO) Training
Disaster Assistance Center Operations
Radiological Emergency Response Evaluators Workshop
Federal Radiological Emergency Response Plan
Public Assistance Course

Question: Would you please provide, for the record, the titles of Non-CD courses that were given under the Resident Programs in FY 84?

Answer: Integrated Emergency Management Course (IEMC)-Mitigation-Pilot
IEMC-Recovery-Pilot
IEMC-Nuclear Accident-Pilot
Radiological Emergency Preparedness Planning
Radiological Accident Assessment

- Radiological Emergency Response Team Course (Conducted in Las Vegas)
- Federal Coordinating Officer Workshop
- Interagency Hazard Mitigation Team Training
- Flood Property Purchase and Relocation Workshop
- Local Flood Plain Management
- Federal Radiological Preparedness Coordination Committee
- Crisis Counseling Seminar
- Temporary Housing Policy Workshop
- Temporary Housing/Project Monitor Workshop
- Flood Insurance Study/Project Monitor Workshop
- Individual and Family Grant Workshop
- Community Relocation (Superfund) Workshop
- Radiological Emergency Response (Nuclear Power Plan) Exercise Evaluators Workshop
- Inspector's Training/Construction Cost Estimate, Train-the-Trainer
- Public Assistance Course, Train-the-Trainer
- Disaster Assistance Center (DAC) Management and Operations, Train-the-Trainer
- Conference on New Disaster Regulations, Train-the-Trainer
- Hazard Mitigation Planning (Section 406)

Question: How much funding was provided for these courses in FY 84?

Answer: The programmatic funds allocated to carry out the resident activities are $805 thousand.

NATIONAL FIRE ACADEMY - FIELD TRAINING

Approximately $13.3 million is being requested for the National Fire Academy in FY 85. This is a 25% increase over the FY 84 appropriation. Almost $2 million is requested for the Training Field Deployment Systems Program in FY 85.

The Field Training Program has attempted to reach a large audience by training the future instructors, developing the materials and having the courses presented at the State level to the widest possible audience.

Question: Would you please prepare a table for the record comparing FY 81 and what is anticipated for FY 85 in Field Training versus Resident Programs in terms of number of students, number of courses and total number of course offerings?

Answer: Comparison of NFA Participation

	1981	1982	1983	1984	1985
Graduates					
Resident	4,034	4,130	4,146	4,350	5,200
Field	6,544	10,935	11,334	13,000	21,000
Courses					
Resident	18	18	24	25	25
Field	10	17	15	15	17
Course Offerings					
Resident	183	189	181	188	200
Field	101	246	272	275	478

DISASTER RELIEF FUND

Question: The President's Budget for FY 85 indicates that outlays for disaster relief and insurance are estimated to be $179 million in 1985. This estimate includes Small Business Administration disaster loans, the Federal Disaster Assistance program and the National Flood Insurance program.

FEMA's FY 85 budget request includes $100 million for the disaster relief fund.

In light of the size of the estimated outlays and the size of the unobligated balance in the Disaster Relief Fund ($539 million as of January 27, 1984), why are you asking for an additional $100 million?

Answer: The President's FY 85 budget for the Federal Disaster Assistance program alone actually projects an outlay of $350 million. This estimate is solely for outlays from the President's Disaster Relief Fund. While our figures for the unobligated balance in the fund show $486 million as of February 29, 1984, we believe the additional $100 million for FY 85 is warranted based on anticipated outlays for the balance of FY 84 as well as the potential for a large scale disaster given that the last several years have seen relatively moderate levels of disaster activity.

Question: How do you determine what appropriation to request for the Disaster Relief Fund each year?

Answer: Historical experience provides a basis for estimating $325 million as an average level of disaster activity in a given year. This amount is then increased by anticipated demands from previous years' disasters for which financial impacts continue to be addressed. In FY 84 no appropriations were requested because the carryover balance was sufficient to address expected needs. Statistical cycles of disaster activity as well as long range predictions and forecasts for disaster potential are also taken into account in developing estimates.

FLOOD STUDIES

Question: Detailed flood studies are performed by private architectural and engineering firms, as well as other Federal agencies like to Army Corps of Engineers and the Tennessee Valley Authority. How much do you estimate will be paid to these firms and agencies in FY 84 -- What are your projections for FY 85?

Answer: The following chart provides a breakdown of flood study contracts awarded for 1984:

(1)	Private Contractors	-	$14,500,000
(2)	Corps of Engineers	-	9,600,000
(3)	United States Geological Survey	-	1,500,000
(4)	Soil Conservation Services	-	1,000,000
(5)	Tennessee Valley Authority	-	640,000
(6)	States	-	290,000
	Total		$27,530,000

For 1985, it is anticipated more studies will be performed by Federal agencies and fewer by private firms. Legislation requires that federal agencies be given the first opportunity to provide the expertise for conducting flood studies, where practical.

NATIONAL FLOOD INSURANCE FUND APPROPRIATIONS

Question: Last year, you requested an appropriation of $37,521,000 for the National Flood Insurance Fund. This year, you are requesting $200,205,000. Would you please explain the basis for the amount requested each year?

Answer: Appropriations are requested each year to repay Treasury borrowings for losses which occurred two years earlier. The 1985 appropriation request of $200,205,000 for the National Flood Insurance Fund repays the Treasury for borrowings to cover flood insurance losses incurred during 1983.

GOAL OF SELF SUPPORTING

Question: Last year, you indicated your objective to make this program self supporting by 1988. Have you changed this estimate since your appearance before us last year?

Answer: The goal of achieving self-supporting the flood insurance program by 1988 has not changed. This means that by 1988, the National Flood Insurance Program will have enough premium income to cover claims generated during an average loss year.

Senator Garn—Continued

FLOOD PLAIN MANAGEMENT

Question: Your opening statement indicates an FY 85 request for $53.6 million for flood plain management. This is a $12 million decrease from the FY 84 appropriations which is all in the area of flood studies and surveys. Why has there been this reduction in the program and is the timing for this reduction in FY 85 significant in any way?

Answer: The original appropriation request for flood studies was reduced by the Office of Management and Budget in anticipation of a study now underway by FEMA in conjunction with the Donnelly Corporation. This study will enable FEMA to decide which of the remaining 7,000 Emergency Program communities should be studied using traditional studies, and which can be converted by utilizing other less expensive methodologies.

Question: At last year's hearing, you indicated that between 100 and 200 communities would not comply with floodplain management ordinances in FY 83. How many did not comply in FY 83?

Answer: At the end of 1983, 136 communities were on the suspended list for noncompliance with flood plain management regulations. Of this number, 55 communities were suspended during 1983. Approximately 58 communities were reinstated during 1983. The majority of suspensions result from the community's failure to adopt flood plain management ordinances during the 6-month compliance period. Many communities adopt the ordinances a few months late and are subsequently reinstated.

Question: What are your estimates of non-compliance in FY 84 and FY 85?

Answer: It is expected that noncompliance will remain at current levels through 1984 and 1985.

CRIME INSURANCE INVESTIGATION

Question: Last year, you indicated that the staff of the Federal Insurance Administration was working with FEMA's Office of the Inspector General and the FBI to investigate cases of possible fraud involving adjusters, agents and policy holders. What is the number of suspected cases where there is fraud?

Answer: There are currently 47 cases of suspected fraud either in court or under active investigation in the Federal Crime Insurance Program.

Question: What is the amount of money involved, and what action has been taken to prosecute these individuals?

Answer: There was approximately $10 million in fraudulent claims which have been submitted to the FCIP contractor and paid as well as these which were submitted but not paid. There are currently 19 individuals serving prison sentences as a result of fraud investigations.

CRIME INSURANCE POLICIES IN FORCE

Question: What is the current total number of policies today and how does this compare to the number five years ago?

Answer: As of February 29, 1984, there are 48,726 crime insurance policies. This compares with 67,215 policies in force as of September 30, 1979.

NATIONAL INSURANCE DEVELOPMENT FUND

Question: In your prepared opening statement, you indicated that you plan to terminate the Crime Insurance Program when its authority expires September 30, 1984. Would you please indicate how many policies there now are under this program?

Answer: As of February 29, 1984, there are 48,726 crime insurance policies.

DISTRIBUTION OF CRIME INSURANCE POLICIES

Question: Would you please provide a percent distribution of the existing policies by State?

Answer: The following chart illustrates the distribution of crime insurance policies by State.

CRIME INSURANCE POLICIES BY STATE
(As of January 31, 1983)

STATE	DATE OF ENTRY	RESIDENTIAL	COMMERCIAL	TOTAL	(%)
Alabama (10)	7/77	728	42	770	(1.6)
Arkansas	8/76	56	14	70	(.1)
California (5)	11/80	1,484	348	1,832	(3.7)
Colorado	9/75	41	43	84	(.2)
Connecticut	8/71	177	43	220	(.4)
Delaware	3/74	98	7	105	(.2)
District of Columbia	8/71	87	167	254	(.5)
Florida (3)	2/74	2,195	560	2,755	(5.6)
Georgia	9/75	320	207	527	(1.1)
Illinois (9)	8/71	519	366	885	(1.8)
Iowa	5/77	4	5	9	**
Kansas	4/73	333	32	365	(.7)
Louisiana	1/82	34	21	55	(.1)
Maryland	8/71	111	197	308	(.6)
Massachusetts (6)	8/71	1,134	416	1,550	(3.1)
*Minnesota	8/76	13	6	19	**
Missouri (8)	8/71	929	221	1,150	(2.3)
New Jersey (4)	2/73	1,534	366	1,900	(3.9)
*New Mexico	6/79	8	3	11	**
New York (1)	8/71	22,056	7,422	29,478	(59.8)
North Carolina	4/78	698	23	721	(1.5)
Ohio	8/71	357	206	563	(1.1)
Pennsylvania (2)	8/71	2,485	915	3,400	(6.9)
Rhode Island	8/71	82	28	110	(.2)
Tennessee	8/72	174	191	365	(.7)
Virginia	1/77	94	19	113	(.2)
*Washington	3/79	4	0	4	**
*Wisconsin	3/79	12	4	16	**
Puerto Rico (7)	6/78	1,097	406	1,503	(3.1)
Virgin Islands	10/78	88	30	118	(.2)
Total		36,952	12,308	49,260	

* While Federal crime insurance is no longer available in these states, the policies shown represent the run-off of the program.

** Represents less than .1% of total policies in force.

NATIONAL DEFENSE STOCKPILE UNOBLIGATED BALANCE

Question: At the time of the October 1983 Stockpile Report to The Congress, there was a $98.7 million balance from sales of materials from the National Defense Stockpile in excess of the funds used to finance acquisitions.

What is the status of the GSA-managed National Defense Stockpile Transaction Fund at the present time?

Answer: As of March 30, 1984, the Transaction Fund had an unobligated balance of $122 million, which consisted of $79 million in appropriated funds and $43 million in unappropriated funds. Since establishment of the Transaction Fund in 1979, a total of $440.6 million in sales receipts has been covered into the fund, of which $397.6 has been appropriated by the Congress. Approximately $318.6 million of this appropriation has been obligated.

Question: What is the anticipated approved spending level for Fiscal Year 1984 and Fiscal Year 1985?

Answer: For Fiscal Year 1984, the anticipated approved spending level is $146.8 million. This spending level includes a $26.8 million carry-over from Fiscal Year 1983 and the Fiscal Year 1984 appropriation of $120 million. The requested spending level in Fiscal Year 1985 is anticipated to be $120 million.

Question: What is the anticipated balance of unobligated funds at the end of Fiscal Year 1984?

Answer: The balance of unobligated funds at the end of Fiscal Year 1984 is expected to be $43 million in unappropriated funds with no balance in appropriated funds.

GRACE COMMISSION

Question: The Grace Commission with its recent Private Sector Survey On Cost Control had as its objective to cut the Federal Government and its expenses down to a manageable size. One of the Commission's 36 Task Forces looked at the National Flood Insurance Program. Would you please comment on its findings and your evaluation of both the accuracy of its information and the conclusions that they came to?

Answer: The Grace Commission made two recommendations relative to the National Flood Insurance Program:

(1) Take steps to make the NFIP actuarially sound; and

(2) Eliminate disaster payments for insurable losses.

FEMA agrees that the NFIP should be actuarially sound and has been working toward that goal since 1981. The $660 million that the Grace Commission estimates will be saved by following this recommendation is in agreement with projections made by FEMA staff.

Senator Garn—Continued

FEMA also agrees that disaster payments should be eliminated for insurable losses. FEMA has submitted legislation to Congress which would accomplish this with regard to public assistance payments, which are aimed at repairing public structure damage by floods.

FEMA does, however, disagree with the estimated savings of over $196 million resulting from a 50% increase in NFIP policies projected by the Grace Commission. This savings can be realized only after the NFIP is actuarially sound. Until all subsidies has been eliminated, increasing the policy base will increase the losses suffered by the NFIP.

NATIONAL DEFENSE STOCKPILE

Question: The Strategic and Critical Materials Stock Piling Act requires that the stockpile inventory be sufficient to cover U.S. needs for not less than three years of a national emergency.

Would you please make a comparison of the current inventory with the stockpile goals?

Answer: The total value of commodities needed to fill stockpile goals is $16.7 billion. The National Defense Stockpile inventory of materials currently held against this total is valued at $6.9 billion. The value of materials currently held in the stockpile but not needed for an established goal totals $4.2 billion. Purchases of additional materials that would be required to meet the current goals total $9.8 billion.

Question: When was the last time the goals were updated to ensure a correct estimate of the nation's vulnerability to resource shortages during an emergency?

Answer: Requirements and sources for specific materials are monitored on a continuous basis and goals are reviewed at least annually in connection with the Annual Materials Plan. No changes in goals have been warranted since they were published in 1980. The National Security Council is currently directing an interagency review of goal methodology.

Question: When will the 5-Year Annual Materials Plan (AMP) for Fiscal Year 1985 and the four forward years be submitted to Congress?

Answer: The FY 85 AMP was submitted on Feburary 2, 1984, consistent with Section 11(b) of the Strategic and Critical Materials Stock Piling Act of 1979. This section requires that the AMP for the operation of the stockpile include the planned acquisitions and disposals of stockpile materials for the next fiscal year and the succeeding four fiscal years.

Question: What is your overall estimate of the current status of the stockpile versus the last 5-year plan?

Answer: Significant progress was made under the last AMP in reducing the shortfall in Priority I materials. With the completion of the FY 85 purchase plan, the following pattern will prevail:

Priority	Percent Satisfied
I	80
II	70
III	50
IV	20
V	10

OMB REQUEST

Question: Is the amount requested in your budget justification different from your OMB request? Would you please indicate those program areas that were increased and those that were reduced? What impact will these changes have upon the programs?

Answer: The following chart provides an Appropriations History by Program for the FY 85 request.

Federal Emergency Management Agency
Appropriation History by Program
FY 1985
(Dollars in Thousands)

	1985 Request to OMB				1985 Request to Congress				Increase/Decrease			
Civil Defense	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total
A. State and Local Emergency Management												
1. Emergency Management Assistance	188	$10,708	$58,000	$68,708	188	$10,855	$58,000	$68,855	...	$147	$...	$147
2. Other State and Local Emergency Management	22	1,170	3,250	4,420	17	993	2,700	3,693	-5	-177	-550	-727
Subtotal, State & Local Emergency Management	210	11,878	61,250	73,128	205	11,848	60,700	72,548	-5	-30	-550	-580
B. Radiological Defense												
1. Planning and Development	13	477	6,000	6,477	13	488	4,300	4,788	...	11	-1,700	-1,689
2. Instrumentation	20	655	21,390	22,045	20	669	15,550	16,219	...	14	-5,840	-5,826
3. Other Radiological Defense	...	...	150	150	...	...	150	150	...	...	...	...
Subtotal, Radiological Defense	33	1,132	27,540	28,672	33	1,157	20,000	21,157	...	25	-7,540	-7,515
C. Population Protection												
1. Population Protection Planning	50	2,007	14,140	16,147	45	1,947	13,200	15,147	-5	-60	-940	-1,000
2. Facility Survey, Engineering & Development	134	5,263	13,600	18,863	119	4,736	9,500	14,236	-15	-527	-4,100	-4,627
3. Shelter Preparation	2	71	2,200	2,271	2	72	1,000	1,072	...	1	-1,200	-1,199
Subtotal, Population Protection	186	7,341	29,940	37,281	166	6,755	23,700	30,455	-20	-586	-6,240	-6,826
D. Protection of Industrial Capability												
1. Industrial Capability Protection Planning	3	167	2,000	2,167	3	190	1,600	1,790	...	23	-400	-377
2. Keyworker Blast Protection	3	146	3,600	3,746	2	102	2,700	2,802	-1	-44	-900	-944
3. Other Protection of Industrial Capability	2	95	1,100	1,195	1	74	900	974	-1	-21	-200	-221
Subtotal, Protection of Industrial Capability	8	408	6,700	7,108	6	366	5,200	5,566	-2	-42	-1,500	-1,542
E. State and Local Direction, Control and Warning												
1. Emergency Operating Centers	33	1,447	21,000	22,447	30	1,454	16,300	17,754	-3	7	-4,700	-4,693
2. State & Local Warning & Communications Sys	15	640	9,310	9,950	15	716	5,900	6,616	...	76	-3,410	-3,334
3. Emergency Broadcast System Guidance & Assist	8	251	5,000	5,251	8	257	4,100	4,357	...	6	-900	-894
4. Other State and Local Direction, Control and Warning	12	376	5,000	5,376	12	386	5,000	5,386	...	10	...	10
Subtotal, State & Local Dir, Cont & Warning	68	2,714	40,310	43,024	65	2,813	31,300	34,113	-3	99	-9,010	-8,911

Federal Emergency Management Agency
Appropriation History by Program
FY 1985
(Dollars in Thousands)

	1985 Request to OMB				1985 Request to Congress				Increase/Decrease			
	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total
F. Research												
1. Research	6	$339	$13,300	$13,639	5	$289	$6,200	$6,489	-1	-$50	-$7,100	-$7,150
2. Systems Integration and Applications	1	62	800	862	1	63	200	263	...	1	-600	-599
3. Systems Development	...	...	4,000	4,000	...	...	2,400	2,400	...	...	-1,600	-1,600
4. Policy and Planning	13	588	1,200	1,788	13	606	500	1,106	...	18	-700	-682
Subtotal, Research	20	989	19,300	20,289	19	958	9,300	10,258	-1	-31	-10,000	-10,031
G. Training and Education												
1. Emergency Management Institute	44	1,803	14,702	16,505	44	1,846	13,102	14,948	...	43	-1,600	-1,557
2. NETC Site Administration	24	753	3,213	3,966	23	741	3,213	3,954	-1	-12	...	-12
3. NETC West Site Administration	...	...	1,085	1,085	...	...	1,085	1,085	...	...	...	...
4. Emergency Public Information	...	...	1,900	1,900	...	...	1,500	1,500	...	...	-400	-400
Subtotal, Training and Education	68	2,556	20,900	23,456	67	2,587	18,900	21,487	-1	31	-2,000	-1,969
H. Telecommunications and Warning												
1. National Warning Systems	32	1,272	20,400	21,672	32	1,292	20,400	21,692	...	20	...	20
2. Washington Warning System	3	130	1,448	1,578	3	125	1,448	1,573	...	-5	...	-5
3. FEMA National Teletype System	21	535	7,000	7,535	21	548	7,000	7,548	...	13	...	13
4. FEMA National Voice System	5	84	452	536	5	88	452	540	...	4	...	4
5. FEMA National Radio System	37	1,144	10,000	11,144	37	1,168	10,000	11,168	...	24	...	24
6. Other Communications Services	24	806	8,000	8,806	14	425	8,000	8,425	-10	-381	...	-381
7. U.S. Army Civil Preparedness Detachment	9	226	800	1,026	9	233	800	1,033	...	7	...	7
8. Decision Information Distribution System	1	35	600	635	1	36	600	636	...	1	...	1
9. DOD Reimbursable Support	...	...	1,200	1,200	...	...	1,200	1,200	...	...	...	...
Subtotal, Telecommunications & Warning	132	4,232	49,900	54,132	122	3,915	49,900	53,815	-10	-317	...	-317
I. Automatic Data Processing (Salaries & Expenses)	20	3,055	...	3,055	20	3,079	...	3,079	...	24	...	24
Subtotal, Civil Defense	745	34,305	255,840	290,145	703	33,478	219,000	252,478	-42	-827	-36,840	-37,667

Federal Emergency Management Agency
Appropriation History by Program
FY 1985
(Dollars in Thousands)

	1985 Request to OMB				1985 Request to Congress				Increase/Decrease			
	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total
II. Comprehensive Emergency Preparedness Planning												
A. Disaster Improvement Grants	3	$84	($2,950)	$84	3	$86	($2,950)	$86	...	$2	$...	$2
B. Earthquake	36	1,425	12,300	13,725	12	391	5,705	6,096	-24	-1,034	-6,595	-7,629
C. Hurricane	9	254	900	1,154	9	259	450	709	...	5	-450	-445
D. Hazardous Materials	13	372	250	622	13	381	250	631	...	9	...	9
E. Dam Safety	5	142	482	624	5	146	82	228	...	4	-400	-396
F. Terrorism	...	...	...	...	...	...	...	...	...	...	...	...
G. Hazard Mitigation Assistance	6	177	250	427	6	181	250	431	...	4	...	4
Subtotal,	72	2,454	14,182	16,636	48	1,444	6,737	8,181	-24	-1,010	-7,445	-8,455
III. Radiological Emergency Preparedness												
A. Fixed Nuclear Facilities	67	2,470	3,589	6,059	67	2,524	3,589	6,113	...	54	...	54
Subtotal,	67	2,470	3,589	6,059	67	2,524	3,589	6,113	...	54	...	54
IV. Federal Preparedness												
A. Government Preparedness												
1. Government Preparedness	858	34,641	109,746	144,387	810	33,297	95,800	129,097	-48	-1,344	-13,946	-15,290
Subtotal,	858	34,641	109,746	144,387	810	33,297	95,800	129,097	-48	-1,344	-13,946	-15,290
B. Emergency Information and Coordination Center												
1. Emergency Information & Coordination Center	8	283	500	783	8	258	500	758	...	-25	...	-25
Subtotal,	8	283	500	783	8	258	500	758	...	-25	...	-25
C. Resources Preparedness												
1. Resources Assessment	9	459	1,050	1,509	8	424	1,050	1,474	-1	-35	...	-35
2. Other Resources Planning	24	1,147	552	1,699	10	531	452	983	-14	-616	-100	-716
3. Economic Resources Planning	9	466	350	816	9	476	400	876	...	10	50	60
4. Natural Resources Planning	16	826	400	1,226	16	847	450	1,297	...	21	50	71
5. Resources Preparedness Program Integration	5	252	200	452	4	211	200	411	-1	-41	...	-41
Subtotal,	63	3,150	2,552	5,702	47	2,489	2,552	5,041	-16	-661	...	-661

Federal Emergency Management Agency
Appropriation History by Program
FY 1985
(Dollars in Thousands)

	1985 Request to OMB				1985 Request to Congress				Increase/Decrease			
	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total
D. Mobilization Preparedness												
1. Mobilization Planning	23	1,085	250	1,335	12	$589	$300	$889	-11	-$496	$50	-$446
2. Mobilization Exercises	13	599	569	1,168	13	636	700	1,336	...	37	131	168
3. Security Planning	17	856	275	1,131	...	...	...	...	-17	-856	-275	-1,131
4. National Defense Executive Reserve	5	228	318	546	4	185	235	420	-1	-43	-83	-126
5. Program Integration	6	275	...	275	5	233	...	233	-1	-42	...	-42
Subtotal,	64	3,043	1,412	4,455	34	1,643	1,235	2,878	-30	-1,400	-177	-1,577
E. Federal Preparedness Policy and Planning												
1. Multiprogram Analysis	2	105	200	305	2	108	200	308	...	3	...	3
2. Policy Planning	19	997	580	1,577	19	1,020	580	1,600	...	23	...	23
Subtotal, Federal Preparedness Policy	21	1,102	780	1,882	21	1,128	780	1,908	...	26	...	26
Subtotal, Federal Preparedness	1,014	42,219	114,990	157,209	920	38,815	100,867	139,682	-94	-3,404	-14,123	-17,527
V. Training and Fire Programs												
A. Emergency Management Institute												
1. Instructional Programs and Materials	3	106	1,061	1,167	...	...	1,061	1,061	-3	-106	...	-106
2. Training Field Deployment System	3	124	985	1,109	...	...	985	985	-3	-124	...	-124
3. Resident Programs	9	396	2,090	2,486	6	253	1,490	1,743	-3	-143	-600	-743
4. Training and Education Projects	...	...	...	...	...	...	...	...	...	...	...	...
5. NETC West Site	...	...	271	271	...	...	271	271	...	...	...	...
Subtotal, EMI	15	626	4,407	5,033	6	253	3,807	4,060	-9	-373	-600	-973

Federal Emergency Management Agency
Appropriation History by Program
FY 1985
(Dollars in Thousands)

	1985 Request to OMB				1985 Request to Congress				Increase/Decrease			
	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total	WY	S&E	EMPA	Total
B. National Fire Academy												
1. Instructional Programs and Materials	10	$459	$811	$1,270	5	$263	$811	$1,074	-5	-$196	...	-$196
2. Training Field Deployment Systems	14	703	2,107	2,810	10	527	1,955	2,482	-4	-176	-$152	-328
3. Resident Programs	25	1,302	2,544	3,846	23	1,212	2,424	3,636	-2	-90	-120	-210
4. NETC Site Administration	42	2,178	2,911	5,089	42	2,210	2,911	5,121	...	32	...	32
5. NETC West Site Administration	...	...	1,357	1,357	...	...	957	957	...	...	-400	-400
Subtotal, NFA	91	4,642	9,730	14,372	80	4,212	9,058	13,270	-11	-430	-672	-1,102
C. U.S. Fire Administration												
1. Fire Prevention and Arson Control	6	260	4,150	4,410	4	183	3,650	3,833	-2	-77	-500	-577
2. Federal Fire Policy and Coordination	5	225	1,000	1,225	5	228	1,000	1,228	...	3	...	3
3. Firefighter Health and Safety	5	225	1,000	1,225	5	228	1,000	1,228	...	3	...	3
4. Fire Data and Analysis	6	269	1,150	1,419	6	274	1,150	1,424	...	5	...	5
Subtotal, U.S. Fire Administration	22	979	7,300	8,279	20	913	6,800	7,713	-2	-66	-500	-566
Subtotal, Training & Fire	128	6,247	21,437	27,684	106	5,378	19,665	25,043	-22	-869	-1,772	-2,641
VI. Flood Plain Management												
A. Flood Studies and Surveys	121	4,352	49,752	54,104	121	4,450	37,352	41,802	...	98	-12,400	-12,302
B. Flood Hazard Reduction	65	2,050	830	2,880	65	2,103	830	2,933	...	53	...	53
C. Purchase of Property	12	371	4,778	5,149	12	381	4,778	5,159	...	10	...	10
D. State Assistance Program	16	492	3,240	3,732	16	505	3,240	3,745	...	13	...	13
Subtotal, Flood Plain Management	214	7,265	58,600	65,865	214	7,439	46,200	53,639	...	174	-12,400	-12,226
VII. Disaster Relief Administration (S&E)	144	6,448	...	6,448	144	6,487	...	6,487	...	39	...	39
/III. Insurance Activities (S&E)	59	2,728	...	2,728	59	2,779	...	2,779	...	51	...	51
IX. Management & Administration (S&E)	458	38,786	...	38,786	433	35,670	...	35,670	-25	-3,116	...	-3,116
TOTAL, Operating Accounts	2,901	142,922	468,638	611,560	2,694	134,014	396,058	530,072	-207	-8,908	-72,580	-81,488

Senator Garn—Continued

MERIT PAY INCREASES

Question: How much money have you included in your FY 85 budget request in order to provide employees with Merit Pay as specified in the Civil Service Reform Act?

Answer: None. In FY 84, $612,000 was requested and subsequently denied.

SENIOR EXECUTIVE SERVICE BONUSES

Question: How much have you included in your budget for SES bonuses during FY 85?

Answer: $70,000 is requested for SES bonuses in 1985. This amount is the same as that requested in 1984.

CONSULTANTS AND EXPERTS

Question: How much do you expect to spend for consultants and experts in FY 84 and FY 85?

Answer: The amount of $530,736 has presently been spent (for first two quarters). Assuming similar spending for the last two quarters, we could project $1,061,472 for FY 84. We have no estimate for FY 85.

Question: Would you please provide a listing by individual or firm of all the funds spent for consultants and experts in FY 83?

Answer: A list of consultants follows:

NAME	AMOUNT	NAME	AMOUNT
Berrey, Thomas G.	$14,400.00	McDonald, Philip P.	$23,496.96
Blatz, Duane A.	34,462.40	McNeese, Harold G.	6,468.16
Borkowski, Susan C.	44,349.75	Minton, Wilfred M.	3,912.72
Brogan, Lawrence N.	2,268.75	Morris, Victor G.	34,034.18
Butters, Timothy P.	22,220.00	Nelson, Otto L., Jr.	942.24
Carson, Carl W.	63,039.39	Noon, Catherine C.	20,536.32
Casper, Andrew C.	28,293.12	Novick, David	1,768.32
Chevalier, Raymond A.	3,153.80	Olsen, Michael F.	18,109.00
Coates, Roger D.	23,403.64	Palumbo, Frank A.	23,716.00
Colgate, Stephen R.	1,469.16	Payne, Francis E.	29,000.00
Collester, J. Bryan	30,600.00	Romagnoli, Julius S.	7,986.00
Collins, John	34,193.75	Schelling, Thomas C.	663.12
Coyle, James F.	32,000.00	Scott, Joanna C.	3,865.52
Diebold-Deruz, Paul	12,864.00	Sears, Andrew F.	10,617.76
Eisele, Moira C.	360.00	Settle, Allen K.	11,383.56
Face, Ronald P., Jr.	43,536.04	Siegel, Irving H.	14,920.20
Feirman, Richard D.	32,600.72	Simms, William H.	12,300.00
Forbes, Karen A.	31,711.46	Simpson, Richard J.	6,221.14
Frazier, Donald H.	9,196.00	Smallberg, Alex	510.72
Girard, Charles M.	17,880.02	Smith, Elisabeth H.	2,009.12
Glover, Arthur C.	1,989.36	Snavely-Dixon, Mary M.	5,525.84
Gordon, Paula	44,240.40	Sneed, Earl M.	9,417.60
Gottlieb, Daniel W.	960.00	Spector, Sam	1,210.00
Greenberg, Irwin	5,220.00	Steinbrugge, Karl V.	3,616.61
Harkenrider, Honey M.	21,194.28	Stoffel, Robert C.	3,315.60
Hermann, Richard L.	30,330.80	Taubenslag, Morris J.	15,125.00
Heyn, Robert N.	12,472.33	Teller, Edward	663.12
Hoeber, Francis P.	5,083.92	Thompson, Bobby Jack	17,019.68
Jenkins, Brian M.	221.04	Towns, Ronald C.	5,626.00
Jones, Herbert C.	36,040.00	Wamsley, Gary L.	4,370.00
Karkashian, John E.	27,996.00	Watt, Graham W.	9,770.75
Kinney, Arlan L.	4,641.84	Whittaker, Hilary E.	7,957.44
Kososki, John F.	5,500.00	Wigner, Eugene P.	1,105.20
Lafferty, Elizabth H.	10,600.00	Winslow, Erik K.	4,710.47
LaFleur, Joseph L.	37,264.80	Winter, Sidney G., Jr.	442.08
Leo, John E.	6,165.68	Wyatt, Thomas C.	56,807.28
Lindsay, William A.,Jr	28,226.40	Zabrowski, Edward K.	28,514.88
Maguire, Eernard A.	24,005.68	Zordan, Thomas A.	1,694.00
Mainey, Joseph A.	23,214.72		
Malnak, Julian	26,496.00	TOTAL, FY 83	1,245,314.96
McConnell, John W.	2,097.12		

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Senator Garn—Continued

PAY SUPPLEMENTAL

Question: You have asked for a $1,064,000 FY 84 pay raise supplemental. How much of your increased pay costs will you be able to absorb?

Answer: FEMA will absorb 50% of the 1984 pay costs. A breakdown of the 1984 Pay Supplemental follows:

(Dollars in Thousands)

	Total 1984 Pay Cost	Amount Absorbed	1984 Pay Supplemental
Salaries:			
Permanent Positions	$1,836	$918	$918
Other Than Permanent	74	37	37
Total, Salaries	1,910	955	955
Benefits:			
Regular	198	99	99
FICA (due to ceiling change)	6	3	3
Health Benefits (due to rate increase)	14	7	7
TOTAL	2,128	1,064	1,064

Question: What would be the impact of Congress not approving this supplemental request?

Answer: As shown in the figures below, without the pay supplemental of $1,064,000, FEMA would lack 3.1 days of funding at the end of Fiscal Year 1984. The last week of the Fiscal Year, September 23-30, could put FEMA in a furlough posture if the supplemental is not enacted.

Appropriation enacted to date		$121,000,000
Anticipated reimbursements		1,145,000
Total available 10/1/83-9/30/84		122,145,000
Obligations as of 3/31/84		70,656,204
Available for obligations 4/1/84-9/30/84		51,488,796
Other objects in plan	5,841,494	
Personnel compensation:		
On board projected to 9/30/84	44,735,203*	
Personnel actions in process	1,976,099	
Total obligations - 4/1/84-9/30/84		52,552,796
Available 9/30/84		(1,064,000)
Requested pay supplemental		1,064,000
Estimated lapse - 9/30/84		...
Cost per pay period for personnel compensation		3,441,170
Daily rate (pp divided by 10) =		344,117
Number of days pay supplemental will fund ($1,064,000 divided by $344,117) =		3.1

*Does not include $350,000 required for the anticipated 0.5% pay increase.

RADIOLOGICAL EMERGENCY PREPAREDNESS

Question: Last summer, the National Governors' Association (NGA) unanimously adopted a resolution concerning emergency planning for nuclear plants relative to the responsibility of State, local and Federal government.

Could you briefly describe the conclusion of the NGA for the record?

Answer: The National Governors' Association (NGA) unanimously adopted a resolution concerning offsite radiological emergency planning for nuclear power plants. This resolution stated the following recommendations:

- The responsibility for developing offsite emergency response plans should be shared by Federal, State, and local governments and the utility.
- The States should assume responsibility for the development of these plans, in the absence of a plan meeting minimum Federal standards.
- The Federal government should be empowered to develop a plan as a "last resort" if all other entities fail to develop an acceptable plan.
- Utilities should lessen the economic impact on States and localities required to develop and maintain emergency response plans by providing financial and other support.
- Congress should direct the Nuclear Regulatory Commission and FEMA to revise their criteria so that local government failure to prepare emergency plans and conduct exercises shall not be a legitimate basis for not issuing or revoking a nuclear power plant license.

Question: Are there any NGA recommendations that you would take exception to and why?

Answer: Comments on Recommendation #3. In offsite planning and preparedness for nuclear reactor sites, FEMA continues to prefer a process involving active State and local participation and commitment. In our view, the primary role of the Federal government is to enhance, not supplant, State and local government capabilities to prepare for and respond to radiological and other types of emergencies.

There has only been one case in the Nation so far where both State and local governmental entities have refused to participate in offsite planning and preparedness, i.e., the Shoreham Nuclear Power

Station in Suffolk County, New York. The available plans have been developed by the utility, Long Island Lighting Company (LILCO). However, in addition to reviewing the LILCO plans and submitting findings to NRC, FEMA has also engaged in considerations necessary to exercise those plans, using certain Federal compensatory measures to substitute for the lacking State and local authorities.

FEMA would not support a recommendation that such Federal assistance be used as a norm. This is a unique case and of course, we continue to hope that the State and local governments will eventually assume their traditional role in offsite preparedness for Shoreham.

Comments on Recommendation #5. It is true that the possibility of a serious accident at a nuclear power plant is low and can often be offset by onsite preventive measures and remote siting of new plants. FEMA continues to prefer State and local government participation and commitment in planning for the protection of the public living near the site. However, these plans are required through NRC, not FEMA, regulation. FEMA has no statutory authority to force a local government to prepare these plans.

Question: What conditions are necessary before FEMA would take action required under the Atomic Energy Act to protect the public health and safety by sponsoring an emergency plan?

Answer: In accordance with FEMA's responsibilities under Executive Order 12241, the Agency has sponsored the development of a Federal response plan (referred to as the "Master Plan") for commercial nuclear power plant accidents. The Master Plan was published on December 23, 1980, in the Federal Register and encompasses the Federal coordinated response of 10 Federal agencies. At the present time, we are developing an expanded Federal plan, the Federal Radiological Emergency Response Plan (FRERP), for all types of radiological emergencies. A draft of the FRERP was published in the Federal Register on January 27, 1984, and tested in an exercise at the St. Lucie power plant at St. Lucie, Florida, in March 1984. A final version of the FRERP is expected to be published in the Federal Register in August 1984. This plan encompasses the roles and responsibilities of 12 Federal agencies. The FRERP will replace the Master Plan as the operative Federal response plan when it is published in final in the Federal Register.

Question: When we met with your Agency last year, they had some question on their authority to review emergency plans that were not generated by State and local governments.

What is the current status of your authority and activities to review plans developed by utilities?

Answer: The Formal "350" Process. In June 1980, FEMA adopted a formal procedure for evaluation of offsite emergency plans and preparedness and published it in a proposed rule, at 44 CFR 350. This rule became effective as a final rule on October 28, 1983.

This process is based on a formal submission by the Governor, or his designee, of the State and local plans for the ten-mile emergency planning zone around a specific nuclear power plant site. The process includes participation by an interagency Regional Assistance Committee (RAC), composed of FEMA and nine other Federal agencies, that reviews the plans and renders advice on their particular areas of expertise. After extensive review, the plans are approved by FEMA's Associate Director for State and Local Programs and Support, if a determination is made following appropriate plan exercises, that the plans are adequate to protect the health and safety of the people living in the vicinity of the nuclear power plant and provide reasonable assurance that appropriate protective measures can be taken offsite in the event of a radiological emergency at the plant. The process does not end with this initial approval. The State and the affected local jurisdictions must continue to keep plans updated and must participate in periodic exercises with the utility as a condition of continued FEMA approval.

The "MOU" Process. Under Section II.4 of the November 1, 1980, Nuclear Regulatory Commission (NRC)/FEMA Memorandum of Understanding (MOU), FEMA may review and provide findings, at NRC's request, on offsite preparedness plans furnished to FEMA by NRC through the NRC/FEMA Steering Committee.

The only site for which FEMA has only reviewed utility-developed plans is the Shoreham Nuclear Power Station, in Suffolk County, New York. The Long Island Lighting Company (LILCO) Transition Plan for Shoreham was submitted, without Suffolk County or New York State endorsement, to FEMA, through NRC, under the terms of the FEMA/NRC MOU.

FEMA's first finding on the LILCO Transition Plan was submitted to NRC on June 23, 1983. The finding was based only on contractor review, due to an extremely short time frame for providing the results to NRC. Based on that finding, LILCO revised the plan three times. FEMA's second finding on Revision 3 of the Plan was submitted to NRC on March 15, 1984. This was the result of a full and independent RAC review. A total of 32 deficiencies remain in the Plan. LILCO is in the process of addressing the correction of the deficiencies.

Question: What are you doing to review emergency plans for nuclear power plants, particularly in areas dependent on imported oil?

Answer: FEMA and other Federal agencies review emergency plans of State and local governments related to nuclear power plants regardless of where those plants are located. This review activity is done in support of the Nuclear Regulatory Commission (NRC) licensing process and in accordance with the procedures outlined in FEMA's rule 44 CFR 350 (48 FR 44332) and a Memorandum of Understanding between NRC and FEMA (45 FR 82713).

RADIOLOGICAL EMERGENCY PREPAREDNESS

There are over 500 State and local jurisdictions potentially impacted by 78 nuclear power plant sites. FEMA has approved, under 44 CFR 350, offsite plans for 24 sites involving 15 States and 65 local governments. Most of the remaining plans are in draft form and are in various stages of FEMA review. At all of the 54 operating sites, State and local governments have participated in exercises with the power plant operators at least twice. These exercises are designed to test whether emergency plans are workable.

Question: For purposes of your review of emergency plans in NRC licensing proceedings, what do you assume State and local governments will do to protect the public health and safety in the event that a nuclear related emergency occurred?

Answer: We assume that State and local governments will implement those aspects of radiological preparedness reflected in the standards and criteria of Federal guidance, NUREG-0654/FEMA-REP-1. This is because this guidance is the basis for State and local governments' development of their radiological emergency planning and preparedness for commercial nuclear power plant accidents as well as the basis for the Federal government's evaluation of their preparedness. Because of the specificity and uniqueness of accidents, we would also expect the application of their preparedness to be made on the basis of both preplanned and ad hoc measures.

QUESTIONS SUBMITTED BY SENATOR HUDDLESTON

FLOOD INSURANCE

Question: In a March 30, 1984, letter you indicated that 90.9 percent of the properties eligible for flood insurance in Kentucky were not insured against flood damage. Why do you think that rate of participation is so low?

Answer: There are two (2) generally accepted explanations of why participation in the flood insurance can be as low as the available data seems to indicate: First, the housing market until recently was stagnant, resulting in little turnover of existing properties and depressed housing starts. These turnovers and new starts in many cases trigger the mandatory purchase requirement for mortgages on structures in the special flood hazard area insured by the Federal Goverment or through federally insured or regulated institutions. As the housing market has improved, the NFIP policy base has begun to increase.

Second, areas where no serious flooding has occurred in recent years have experienced a decline in flood insurance policies. States such as Kentucky, which are not as susceptible to the catastrophic impact of hurricanes as coastal States such as Texas or Louisiana, show a much lower percentage of insured structures. Thus, the perceived exposure in terms of both frequency and potential damage affect the homeowner's decision to purchase flood insurance.

Question: Please provide a State list showing percent of eligible properties not insured. Are there any patterns among states or areas regarding nonparticipation?

Answer: The following chart provides the total number of structures reported to be in the community and in the designated special flood hazard area, as reported by communities in their annual reports, the number of policies, and the percentage of structures insured by State. The data indicates that participation is highest in coastal States, where recent flooding has occurred, and lowest in noncoastal States, many of which have not experienced flooding in recent years.

STATE	STRUCTURES		POLICIES		% OF HAZARD STRUCTURES INSURED
	TOTAL	HAZARD	NUMBER	AMOUNT	
Alabama	1,223,735	586,895	15,130	$794,240,800	2
Alaska	63,207	11,735	3,250	183,961,600	28
Arizona	1,366,528	92,756	25,743	1,368,796,400	28
Arkansas	643,705	75,481	6,824	230,521,000	9
California	6,585,007	922,252	103,821	6,561,483,000	11
Colorado	841,695	61,704	9,115	500,163,900	15
Connecticut	899,805	67,423	15,303	865,378,700	27
Delaware	204,008	11,248	4,952	364,091,600	44
District of Columbia	111,802	190	38	2,415,600	20
Florida	4,178,431	1,157,054	543,700	36,443,306,500	47
Georgia	1,297,183	84,419	14,895	744,040,400	18
Guam	19,095	2,500	21	675,500	.8
Hawaii	208,297	24,018	6,703	559,078,900	28
Idaho	1,255,799	17,719	2,275	104,616,100	13
Illinois	2,971,505	226,198	24,667	846,052,000	11
Indiana	2,538,109	77,831	12,154	379,899,200	16
Iowa	841,923	76,345	6,593	207,904,600	9
Kansas	853,123	72,784	7,408	242,586,500	10
Kentucky	728,102	186,523	16,408	627,248,500	9
Louisiana	1,476,729	424,159	241,000	14,010,923,400	57
Maine	1,160,155	30,700	5,009	173,808,200	16
Maryland	1,056,500	43,475	15,244	878,415,900	35
Massachusetts	1,523,825	131,847	24,462	1,131,842,700	18
Michigan	1,921,167	193,101	11,104	399,488,200	6
Minnesota	923,307	56,333	6,761	263,031,300	12
Mississippi	658,223	126,801	39,016	1,835,260,300	31
Missouri	1,199,429	56,799	15,930	514,291,600	28
Montana	695,509	33,064	2,270	84,164,600	7
Nebraska	784,759	36,138	7,736	294,951,200	21
Nevada	247,663	31,667	6,160	265,611,600	19
New Hampshire	270,283	16,937	2,735	104,240,600	16
New Jersey	1,493,513	237,908	88,608	5,334,740,000	37
New Mexico	502,746	77,375	4,369	163,479,000	6
New York	3,698,907	484,346	71,570	2,989,783,500	15
North Carolina	1,762,313	140,332	27,139	1,479,204,700	19
North Dakota	147,000	25,926	6,142	206,126,600	24

STATE	STRUCTURES TOTAL	STRUCTURES HAZARD	POLICES NUMBER	POLICES AMOUNT	% OF HAZARD STRUCTURES INSURED
Ohio	3,226,512	153,781	17,449	564,638,200	11
Oklahoma	838,752	43,443	9,573	497,067,900	18
Oregon	720,621	68,713	5,964	277,795,100	9
Pacific Trust	4	4	0	0	0
Pennsylvania	4,272,648	281,354	70,734	2,597,008,800	25
Puerto Rico	640,629	29,500	13,702	289,858,800	46
Rhode Island	251,125	20,617	6,982	382,040,000	34
South Carolina	937,965	69,758	28,610	2,172,794,900	41
South Dakota	147,600	8,731	1,031	41,205,300	12
Tennessee	1,031,158	40,922	6,033	236,562,600	14
Texas	4,512,217	323,822	277,545	21,068,009,600	85
Utah	499,124	36,975	4,665	181,039,500	13
Vermont	151,052	15,514	2,215	72,089,100	14
Virgin Islands	34,650	2,543	2,427	92,576,000	95
Virginia	1,383,040	161,962	27,453	1,723,335,800	17
Washington	1,652,237	122,893	16,961	1,020,936,900	14
West Virginia	701,363	224,353	15,416	473,761,900	7
Wisconsin	1,829,383	59,824	5,846	199,580,400	10
Wyoming	150,340	8,766	1,429	73,705,300	16

FLOOD INSURANCE

Question: Do you have any estimate of the total value of property eligible but uninsured throughout the U.S.?

Answer: While there is no figure available concerning the total value of insured structures in the flood plain, an estimate can be derived. Approximately 25% of the potential market is currently covered by flood insurance. In addition, the average single family structure, which represents the vast majority of the NFIP policy base, is valued at approximately $50,000. Thus the uninsured structures can be estimated at over $280 billion.

Question: To what extent are premiums the cause of nonparticipation?

Answer: Two recent studies, by the General Accounting Office in February, 1983 (GAO/RCED-83-107), and subsequently by FEMA staff, both found that the policy base is relatively insensitive to price increases. FEMA believes nonparticipation is related to the lack of mortgage turnovers, and the absence of serious flooding in many areas in recent years.

Question: Please provide a list showing the number of nonparticipating communities in each state. Why are these communities not participating?

Answer: The table below illustrates by State the number of communities with identified special flood hazard areas not participating in the National Flood Insurance Program. The communities listed are not participating for two main reasons: suspension from the NFIP for not adopting flood plain management ordinances, and lack of interest on the part of the community.

Some communities do not adopt the flood plain management ordinances by the required deadline. This usually occurs in cases where the identified special flood hazard area is relatively small with little or no immediate development potential. In 1983, 55 communities were suspended for this reason, while 58 were reinstated. A total of 136 communities were on the suspended list at the end of 1983.

Many smaller communities also do not feel the special flood hazard area in their community is significant enough to warrant ordinance changes which are required to participate in the NFIP. These communities voluntarily decide not to participate.

Senator Huddleston—Continued

COMMUNITIES WHICH HAVE HAD SPECIAL FLOOD HAZARD AREAS IDENTIFIED --NOT IN THE PROGRAM-- AS OF APRIL 15, 1984

STATE NAME	NUMBER OF COMMUNITIES
Alabama	111
Alaska	3
Arkansas	91
California	10
Colorado	24
Florida	15
Georgia	115
Idaho	19
Illinois	121
Indiana	62
Iowa	216
Kansas	144
Kentucky	76
Louisiana	25
Maine	58
Maryland	5
Massachusetts	27
Michigan	30
Minnesota	165
Mississippi	37
Missouri	138
Montana	28
Nebraska	62
Nevada	1
New Hampshire	61
New Jersey	9
New Mexico	20
New York	26
North Carolina	64
North Dakota	35
Ohio	107
Oklahoma	99
Oregon	2
Pennsylvania	30
Rhode Island	1
South Carolina	50
South Dakota	61
Tennessee	143
Texas	337
Utah	32
Vermont	54
Virginia	25
Washington	27
West Virginia	1
Wisconsin	62
Wyoming	23
Pacific Trust	1

Question: Is any protection available for persons with property in nonparticipating communities?

Answer: No flood insurance policies are issued in nonparticicipating communities. If a community withdraws from the NFIP after flood insurance policies have been issued, those policies will be honored until their term expires. However, the policyholder will be unable to renew. If a flooding event occurs in a nonparticipating community, that community will be ineligible for federal disaster relief funds.

Additionally, the nonparticipating community is ineligible for federal funds for construction or development in the designated special flood hazard area.

Question: Do you have any concerns about a program in which participation is so low?

Answer: The level of participation is of concern to FEMA. This concern has resulted in the development of public service announcements to educate the public, and an effort to utilize the insurance industry to reach potential flood insurance policyholders. This program, known as the Write-Your-Own, allows private insurance companies to write flood insurance under their own name on a non-risk basis. One of the goals of this program is to expand the NFIP policyholder base both geographically and numerically to achieve the Program's goals of actuarial soundness by 1988.

Question: Are we likely to see the program become self-supporting by lack of participation or lack of participation by high risk areas?

Answer: The nearly 2 million policies in force in the National Flood Insurance Program does represent a significant level of participation by individuals subjected to the threat of flood losses. However, FEMA is taking steps which will enable it to reach those individuals not now insured against losses due to floods, and as a result expand the NFIP policy base in order to more easily achieve the goal of actuarial soundness. Through efforts such as the Write Your Own Program, FEMA is seeking both numerical and geographic expansion of the policy base which will enable the NFIP to more accurately determine the flood insurance rates necessary to achieve actuarial soundness, while keeping those rates at reasonable levels.

Senator Huddleston—Continued

DAM SAFETY

Question: Please provide annual appropriation levels for FEMA's dam safety activities in FY 83 and FY 84.

Answer: FEMA's appropriation levels for dam safety activities were $422,000 in FY 83 and $482,000 in FY 84.

Question: Please elaborate in detail how FEMA spent its dam safety funds in FY 83 and FY 84.

Answer: The following table shows expenditures for dam safety:

Item	Expenditures	
	FY 83	FY 84
I. State Financial Assistance for Dam Safety	$230,800	$314,600
II. Multihazard Projects (Utah & IEMS Support)	60,000	
III. State Informational Workshops	46,408	69,400
IV. Develop Dam Safety Techniques, Guidelines and Processes		
A. Risk-based Analysis Workshops	63,579	65,000
B. Technical Informaton Development and Dissemination	21,213	33,000
	422,000	482,000

Question: How much is FEMA requesting for dam safety activities in FY 85?

Please detail which dam safety activities will be dropped or reduced due to such a large decrease in funding for the program.

Answer: FEMA is requesting $82,000 for dam safety in FY 85. State Finanicial Assistance and Risk-based Analysis Workshops will be dropped from the program. Printing and dissemination of technical assistance material will be reduced to accommodate the decrease in funding.

Question: Please detail FY 83 and FY 84 expenditures for financial assistance to State dam safety programs.

Answer: Fiscal Year 1983

1. Connecticut (15,900)	- Develop a dam inventory data base management system.
2. Georgia (42,500)	- Establish a multi-State program* for inspecting pipe outlet works at small earthen dams by purchase of a TV inspection device for mutual use, training and maintenance.

Senator Huddleston—Continued

3. Minnesota (33,000)	- Prepare an emergency preparedness plan for dam failures.
4. New York (71,000)	- Perform a risk-based analysis, improve system for dam inspection and correcting dam deficiencies, and the development of emergency planning guidelines. State dam safety workshop.
5. Pennsylvania (13,000)	- Publish an owner's guideline manual for evaluation, operation, maintenance, and inspection of small earth dams. Also, update and maintain inventory.
6. Vermont (9,000)	- Update the State's dam inventory.
7. Wisconsin (40,000)	- Update and correct the dam inventory to be used as a basis for the development of an inspection program.
8. Wyoming (6,400)	- Develop procedures for emergency preparedness plans for high and moderate hazard dams.

Fiscal Year 1984

1. Alabama (20,132)	- Draft legislation to establish a Dam Safety Program on which to build legal and financial liabilities.
2. Arkansas (29,644)	- Produce a publication to assist dam owners in the inspection and maintenance of their structures with emphasis on financial responsibility and legal liability. Also, develop guidelines for emergency action plans to include breach analysis and inundation mapping of high hazard dams.
3. Colorado (2,040)	- Conduct community awareness and planning project. Through public awareness and community involvement, develop warning and evacuation plans, at the local level, assisted by the State.
4. Georgia (6,000)	- Develop an operation and maintenance manual for dam owners to provide insight to the operators as to what precautions and maintenance procedures are necessary for the successful and safe operation of dams.

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* The States were Georgia, Florida, Mississippi, North Carolina, South Carolina, Tennessee and Virginia.

5. Kentucky (25,000) - Develop and distribute two publications to owners on dam breach analysis and guidelines for maintenance and inspection of dams. Also, conduct a breach analysis on a State dam as a basis for future emergency evacuation procedures to dam owners.

6. Maine (22,400) - Update and computerize the State's inventory by verifying the existing inventory through a dam registration program.

7. Michigan ** (40,150) - Develop a dam safety guidebook to provide information to dam owners and operators on operation, maintenance, and repair of dams.

8. New Jersey (20,050) - Prepare a guidebook and State manual for owners which includes an emergency action planning guide, appropriate State dam safety laws and general maintenance instructions.

9. New Mexico (18,000) - Perform breach analyses on 25% of the remaining unsafe dams to determine if the spillway capacity is acceptable to the State engineer. If not, the owners will be required to modify their structures.

10. North Carolina (20,000) - Develop brochures for dam owners explaining emergency response along with inspection and maintenance procedures.

11. North Dakota (30,000) - Develop a dam design standards manual describing the basic principles and define the standards for dam construction that apply to the needs of the State.

12. Ohio (33,300) - Update and computerize the inventory subject to State's laws to provide for improved enforcement and implementation of inspection and construction permit statutes. Also, disseminate information on emergency preparedness planning.

** This is a multi-State effort including Illinois, Indiana, Minnesota, Nebraska, and Wisconsin. To accommodate special State needs, additional funds were provided directly to Indiana ($1650), Minnesota ($2000), and Nebraska ($3950).

13. Oklahoma (31,884)	- Formation of an advisory committee to evaluate and make recommendations in conjunction with the State in developing a progressive State Dam Safety Program.
14. Washington (8,400)	- Update and computerize the inventory which will serve as a foundation for developing an inspection and emergency action plan review system.

Question: Please explain why there is such a large cut in the financial assistance program.

Has this program been successful?

What are some of its achievements?

Answer: The financial assistance program has been dropped because non-Federal dam safety is inherently a State responsibility. Therefore, in a time of limited budgetary resources FEMA is emphasizing that the States assume their appropriate role in funding dam safety programs.

The program has been very popular with the States. Since progress reports for projects initiated in FY 83 and FY 84 are only now being received, it would be premature to assess the success of this program at this time.

Question: Please detail and give reasons for the proposed funding cuts in the risk methodology workshop program.

Have these workshops been successful?

Please comment on their popularity and accomplishments.

Answer: Risk methodology workshops were supported with FY 83 and FY 84 funds. Host selection and other scheduling problems will extend the workshops into late calendar year '84. Funding cuts in FY 85 will tend to return the program to our original schedule.

The two workshops held to date have been successful and popular. We have reached in excess of 100 dam safety professionals and fully expect the remaining 8 sessions to reach a large audience. The purpose of the workshops is to acquaint the technical community and dam safety managers with risk-based techniques useful in decision-making regarding dam safety rehabilitation and to provide hands-on experience with the risk based methodology developed by Stanford University for FEMA. Based on our initial survey of attendees, the purpose is being achieved.

Question: Please provide the subcommittee with several options for transferring $100,000 to FEMA's dam safety program without impairing the ability of other FEMA programs to achieve their major goals.

Answer: It is really far too early in the appropriations process to provide the subcommittee with anything but an arbitrary response to this issue. Once overall appropriations levels are fixed by the Congress, the Director will be able to weigh the relative values and affix program by program resource levels. This will, of course, be coordinated with the subcommittee through the submission of FEMA's annual operating budget.

FEMA EMERGENCY FOOD AND SHELTER PROGRAM

Question: Has all funding under the Emergency Food and Shelter program been obligated? Expended?

Answer: The $100 million appropriated to FEMA under Public Law 98-8 for the Emergency Food and Shelter Program was obligated by September 30, 1983. Both the State program and the National Board program called for a program completion date of March 31, 1984. Because some States have refused to audit this program separately, but rather in accordance with OMB Circular A-102, Attachment P, actual expenditures for the State program is not yet known. Audit completion for the National Board program is currently scheduled for June 30, 1984, at which time actual expenditures will be known.

The supplemental $40 million provided to the National Board had to be obligated by March 31, 1984, and expended by May 15, 1984, with an audit completion of September 30, 1984.

Question: Did FEMA exercise any oversight or play any role in determining the use of implementation of programs conducted through the national voluntary organizations?

Answer: As was mandated by the legislation, a representative of FEMA serves as Chair of the National Board. In this capacity, FEMA has an equal vote in the decisions made by the Board for the administration of the program. FEMA has overall responsiblity for the program including such areas as oversight, audits and reporting requirements.

Question: Were there many recaptures and/or reallocations of the funds that went directly to the States?

Answer: As a result of the program completion date being set at March 31, 1984, and some States conducting their audit in accordance with OMB Circular A-102, Attachment P, the recapture of funds that went directly to the States has been minimal to date. Due to the emergency nature of the program and the limited time frame to complete it, no reallocations of funds will be accomplished. Any funds recaptured will be returned to the General Fund of Treasury.

Question: The next general supplemental appropriations bill is likely to include $60 million for an emergency shelter program. Is FEMA prepared to allocate these funds expeditiously? Will new regulations be necessary and, if so, have they been drafted?

Senator Huddleston—Continued

Answer: FEMA is prepared to allocate any additional funds appropriated as expeditiously as possible. We don't anticipate any problems in allocating the funds quickly. If this were to become a continuing program, regulations would be necessary in lieu of the "guidelines" that was developed for the emergency, one-time program. Due to the uncertainty of the funding mechanism for the implementation of the program, i.e., through the States or through the National Board of Voluntary Organizations, new regulations have not been drafted.

INTEGRATED EMERGENCY MANAGEMENT SYSTEM (IEMS)

Question: Over the past several years, FEMA has been moving toward an integrated emergency management system. This budget continues to promote program separation through specific line items. Additionally, requests for "planning" money are scattered throughout the budget. What do you plan to do to alleviate this artificial separation?

Answer: Much of FEMA's authorizing legislation is hazard specific, therefore major changes in FEMA's budget structure cannot be made without legislation. Before proposing such changes, we want to be very sure that they are beneficial.

FEMA has two efforts underway which address inconsistencies between FEMA budget and funding categories and IEMS functional areas. First, our FY 85 program emphasis guidance to States relates program elements in our current budget structure to IEMS functional capabilities. We hope to transition to a functional/capability-based Comprehensive Cooperative Agreement by FY 86. This will allow States more flexibility in using available resources to meet identified needs.

In addition to the above, a FEMA Task Force is studying the feasibility of more closely aligning FEMA Budget categories to IEMS functional areas. A number of options are being studied, including those requiring revised legislation. It should be noted that implementation of IEMS is resulting in some organizational realignments at the State level where, for example, those responsible for nuclear attack planning and those responsible for natural disaster planning have been consolidated into a single unit.

Question: What specific results can we expect in the way of actual products and reduced administrative costs?

Answer: It is too soon to assess the financial benefits of such a consolidation, but we are monitoring these changes with interest.

Senator Huddleston—Continued

NETC WEST PROPOSALS

This budget indicates you plan to establish NETC West, which, I understand, is to be in Nevada. I have several questions about it.

Question: Why is such a facility necessary when you have a center in Emmitsburg, Maryland?

Answer: The Federal Emergency Management Agency (FEMA) promotes professional development of the Nation's emergency managers through its National Emergency Training Center (NETC) in Emmitsburg, Maryland. As of May 1983, the NETC facility was approaching maximum physical capacity in the face of growing demand for its services. Consequently, during the period from June 1, 1983 through February 17, 1984, 2203 qualified applicants to the training program had to be turned down. A western facility offers major benefits over a comparable capacity expansion at Emmitsburg. As currently structured, NETC offers several programs of instruction. These include resident instruction, outreach programs, and weekend programs. The weekend enhancement program provides intensive weekend instruction, but is thus essentially limited to persons within reasonable driving distance to Emmitsburg. A western facility would enlarge the potential student body exponentially. An additional benefit of the western facility is its proximity to the localities of decision/policy making emergency management students who are generally precluded from traveling far from their assigned areas due to their responsibilities.

Question: You have NETC West funds listed in several places in the budget. What is the total cost and will you pursue this project even if these funds are not approved?

Answer: The initial costs for the acquisition and renovation are estimated at $15,599,599 and the annual budget for the campus for the out-years is estimated at $4,335,862 which must be adjusted each year to reflect the impact of inflation.

Question: If so, where will you get the necessary funds?

Answer: This project cannot be pursued unless the necessary funds are approved by the Congress.

EARTHQUAKE

Question: Earthquake planning efforts and funds have historically been channelled to the far West. What are your FY 85 commitments?

Answer: Five of the six basic budget categories included in FEMA's $5,705,000 FY 85 earthquake budget have national application and are not geared to specific sections of the country: Seismic Design and Engineering Research $2,650,000; Earthquake Education and Information Transfer $355,000; Multi-Hazard Preparedness Planning $250,000; Federal Response Planning $350,000; and, Earthquake Hazards Mitigation Strategies $100,000. This totals $3,705,000.

The remaining $2,000,000 comprises the State and Local Preparedness Planning Program whereby funds are distributed to support activities in specific earthquake prone areas. The distribution of funds in FY 85 is being planned as follows:

Northeast	$285,000	
Southeast	50,000	
Central U.S.	490,000	
West (Rockies)	50,000	
Far West	1,125,000	(California, Hawaii, Alaska, Washington)
	$2,000,000	

Question: What is involved in the study to examine the feasibility of and the need for an earthquake experiment facility? How much will it cost?

Answer: The study is being conducted by the Ad Hoc Committee on Earthquake Engineering Facilities and Instrumentation of the National Research Council with guidance by FEMA and the Office of Science and Technology Policy (OSTP) and funding by FEMA. The Committee is examining such questions as: the needs of the National Earthquake Hazards Reduction Program that only large-scale experimental facilities can satisfy, if any; suitability of existing facilities to fulfill these needs; alternative managerial and physical arrangements; possibility of private sector funding for a large facility; types of research programs that would utilize it; and costs of such a facility.

The Committee is currently scheduled to provide the sponsor with initial findings, and recommendations at the end of June 1984 at which time a preliminary cost estimate is expected to be available.

TELECOMMUNICATIONS AND WARNING

Question: Funds requested for NAWAS continue to escalate. What do you plan to do to eliminate or reduce these costs in the future?

Answer: The 1985 request for NAWAS will allow FEMA to initiate the phased upgrade of existing terrestrial systems into a more survivable infrastructure by using the techniques of low frequency broadcast and Meteor Burst communications. Existing warning systems, with their almost total dependence on leased communications facilities, are considered to be outdated and vulnerable in terms of current potential crisis scenarios. This initiative is a much needed effort to consolidate and update these systems into one efficient, cohesive, and survivable architecture. The proposed system will begin implementation in 1985 and be fully operational in 1987. It will maintain an acceptable level of survivability over an extended period of time by exploiting the techniques of equipment design and media diversity, by using both Low Frequency and Meteor Burst technology, resource distribution, redundancy, mobility, dispersion, deception, responsive system control, reconstitution, and electromagnetic pulse protection. Upon completion of this system upgrade, current cost should be reduced significantly by the elimination of selected commercial leased service charges.

STATE AND LOCAL DIRECTION, CONTROL AND WARNING

QUESTION: State and local governments have a tremendous need for support in communications and warning systems and for financial help to maintain such systems. This budget reflects very little emphasis in that area. Why?

ANSWER: In FY 1984, the Federal Emergency Management Agency (FEMA) obligated $2.7 million to State and local governments with an equal cash match on the part of State and local governments for a total expenditure of $5.4 million for the purchase and installation of communications and warning equipment for upgrading State and local operational capabilities.

For FY 1985, FEMA is requesting $5.9 million in Federal monies for the support of funding State and local governments in upgrading their emergency communications and warning operational capabilities. Should FEMA receive this level of funding authority for communications and warning equipment procurement and installation, this will mean that approximately $12 million will be expended by State and local governments for this effort. This constitutes almost a 100 percent increase over the equivalent investment made in 1984.

In FY 1984, FEMA obligated $3 million for maintenance and services of existing warning and communications systems and EOC's. A management study done in FY 1983 indicated that a significant amount of that went for recurring line charges. We are trying to cause State and local to shift the maintenance funds to preventive maintenance repair and replacement and away from the escalating land line charges. Therefore, in FY 1985, we have not requested any significant increase in this amount.

RESEARCH AND DEVELOPMENT BY PRIVATE CONTRACTORS

Question: How much are you planning to spend on research and development projects with private contractors and how will your projects provide direct, measurable benefits to the public?

Answer: FEMA estimates that approximately $3.5 million will be contracted directly to private contractors for civil defense research and development projects during FY 1985. An additional $3 to $4 million will be spent on work managed by private sector firms who manage selected federal laboratories under contract with cognizant agencies. A certain portion of these funds, approximately $1 million, is expected to be subcontracted to other private firms. Most of the remainder will be used to take advantage of unique capabilities of the federal laboratories' testing facilities and to adapt work already performed by these organizations for other purposes to meet FEMA research objectives.

These research and development projects will provide direct, measurable benefits to the public primarily through the application of results to increasing state, local and federal emergency management capabilities in such areas as communications, warning, evacuation, sheltering, emergency and disaster health and medical provisions, and post-disaster recovery planning.

EMERGENCY MANAGEMENT ASSISTANCE (EMA)

Question: An increase in EMA funds is requested. Will you be using the same formula for allocation as was used in FY 84? If not, what formula will be utilized?

Answer: FEMA proceeded through the rulemaking process for the revised State and Local Emergency Management Assistance Program regulation by publishing in the Federal Register for comment an Advance Notice of Proposed Rulemaking. This was followed by a Notice of Proposed Rulemaking and a Final Rule (44 CFR 302) September 28, 1983. The primary purpose of soliciting comments on the proposed rule was to obtain public opinion on a revised formula allocation method brought about by an amendment to the Federal Civil Defense Act under which the EMA program is administered. This amendment requires that in allocating funds due regard be given to areas that may be affected by natural disasters. Also, the allocation formula and various other provisions of the regulation needed revision to reflect changes in civil defense concepts, needs, and conditions.

The revised formula was in effect for Fiscal Year 1984 and will be used in Fiscal Year 1985. The formula computation includes a reserve of 2% of the appropriated funds to be used first to fund the territories, with the remaining balance of the reserve fund constituting a supplemental fund from which the FEMA Director will consider State requests for additional funding. The criteria for eligibility to receive a portion of the supplemental funds may change from year to year based on the program emphasis and objectives.

FEMA is reviewing and evaluating the impact of the formula from the point of view that changes will be made in the future if they can be clearly substantiated as improvements.

PORTION OF IEMS PRIMARILY ATTACK-RELATED

Question: What portion of the Integrated Emergency Management System (IEMS) would be utlized only during a nuclear attack? Please explain your answer fully.

Answer: The capacity built in each functional area of IEMS (e.g., organization, planning, alert and warning, public information, shelter protection, evacuation) would be used in any type of emergency depending on degree of severity. Nuclear attack would require full use of all capabilities at all levels of government in every functional category of IEMS.

There are some portions of the funds which could be considered primarily attack-related. Out of the $219 million of program funds requested for FY 1985, approximately $7.8 million (under 4 percent) is a reasonable estimate of attack-related items. These items include:

-- $2.7 million for developing and testing emergency shelters for the workers of essential industries (although these shelters could also save lives in a tornado or major fire or explosion).

-- $1.95 million for electromagnetic pulse protection devices and site surveys (though even here at least two cases have been reported where EMP devices protected equipment against lightning).

-- $3.1 million of the $9.3 million research request could be considered mostly attack-related.

In addition to program funds, $9 million of Salaries and expenses (a pro-rata share of 4 percent of the $33.5 million total) could be considered attack-related.

While the 4 percent figure may appear to be a low estimate, one must remember that it reflects: (1) the fact that the same functions are required to save lives in an emergency of any kind; and (2) the actions FEMA has taken to make virtually all activities multi-hazard.

PORTION OF REQUEST SAME AS PREVIOUS REQUESTS

Question: What portion of your request is the same or effectively the same as previous requests for civil defense?

Answer: The portions of the FY 1985 request which are the same or effectively the same as previous requests for civil defense are those elements which are and have always been inherently multiple-purpose in nature. These include, for example, State and Local Emergency Management; State and Local Direction, Control and Warning (e.g., Emergency Operating Centers); Training and Education; and Telecommunications and Warning.

The elements which are not effectively the same as previous requests are those elements of the civil defense program which have been substantively changed to maximize their applicability to emergencies of all types. As discussed in more detail elsewhere, FEMA has made substantive changes to its programs to maximize their multiple-hazard applicability. This includes broadening activities by FEMA-funded State planners to include development of multiple-hazard local plans; expanding activities by State Radiological Defense Officers to address responses to all emergencies involving hazards from radioactive materials; and broadening the shelter survey to identify protection against domestic hazards of various types (e.g., tornadoes).

In FY 1983 and prior years, these programs were nearly entirely attack-oriented. In FY 1984 they are being made multiple hazard in nature under the Integrated Emergency Management System (IEMS). FY 1985 will see the intensification of IEMS and its broad deployment.

PREVIOUSLY DENIED ITEMS

Question: Do you have any requests for items which are virtually identical to items which have been denied by Congress in the past? Please explain.

Senator Huddleston—Continued

Answer: To the best of our knowledge there has been no identical items denied by Congress in the past. Our only problem is each year funding for a badly needed upgrade and modernization program is considered for deferral due to lack of funding. Congressional principles have always believed in and supported enhancements to the communications and warning systems. With the best of intentions, however, various program elements have been delayed due to overall funding constraints or unacceptable program strategies. FEMA has formulated an excellent strategy under the National Emergency Management System (NEMS) for gathering, processing and exchanging information in support of the emergency management community at the Federal, regional, state and local levels of government.

EMERGENCY INFORMATION AND COORDINATION CENTER

Question: Under what circumstances, other than a nuclear war, would you expect the Emergency Information and Coordination Center (EICC) to be fully operational?

Answer: The FEMA EICC is fully operational on an around-the-clock basis to deal with the centralized management of information, and carry out coordination functions associated with the full range of emergencies and disasters. This includes heavy involvement in natural events and the ever-increasing spectrum of man-made situations (i.e., hazardous materials).

The EICC would remain in operation during any national emergency short of actual or eminent nuclear exchange. These would include conventional war(s), periods of severe international tension, terrorist activities against the United States, civil disorders, economic dislocations stemming from foreign or domestic origins, and accidents involving nuclear and hazardous materials.

Those functions performed by the EICC in the national security sphere would be taken up by FEMA facilities maintained at alternate locations during a nuclear war.

COMMUNICATIONS AND WARNING SYSTEMS

Question: In general terms, what is your evaluation of the existing communications and warning systems?

Answer: The systems are generally of a pre-solid state and mid-50's vintage. Systems are obsolete, bulky, difficult to repair -- spare parts are not available and must be fabricated -- and not energy efficient. As a result of these antiquated equipment, frequent and extended outages occur, which could result in FEMA being unable to disseminate critical warning and operational messages in times of natural, man-made, or nuclear disasters.

While the states and locals are acquiring more modern, more capable and less maintained equipment, we at FEMA are rather embarrassed to continue to exhibit "museum pieces". This country cannot afford such a lack of credibility to provide emergency preparedness services.

MULTI-HAZARD MODIFICATIONS IN THE CIVIL DEFENSE PROGRAM

Question: What do you mean by "substantive modifications" to the civil defense program elements so that virtually all activities are multi-hazard in nature? Are you doing anything more than adding new civil responsibilities on top of those for nuclear attack?

Answer: The more important substantive changes in the civil defense program include: broadening activities by FEMA-funded State planners to develop multi-hazard local emergency plans; expanding activities by State Radiological Defense Officers to address response to all emergencies involving radioactive materials; and broadening the shelter survey to identify protection against natural disasters and other threats.

In FY 1983 and before, Nuclear Civil Protection Planners devoted nearly all their time to developing plans for the contingency of enemy attack. Starting in FY 1984, they have been designated as Population Protection Planners and they are helping local governments to develop plans for all likely hazards. Where relocation plans were developed in 1976 through 1983, these will be refocused to address the evacuation from all hazards likely to affect a specific community. (Some 1480 localities have completed relocation plans, almost half of the 3135 local jurisdictions needing such plans.) In general, all current single-purpose plans--whether for hurricanes, earthquakes, floods or enemy attack--will be integrated into full-spectrum plans.

Similarly, starting in FY 1984 the State Radiological Defense Officers (RDOs) funded by FEMA are expanding their activities to address plans and capabilities for response to all emergencies involving radioactive materials--such as transportation accidents or accidents at nuclear power plants. The multi-hazard approach is also being reflected in our Radiological Instrumentation effort.

The shelter survey, hitherto attack-oriented, is likewise being broadened to identify protection against natural disasters and other threats--again a substantive change. Surveys conducted from the mid-1970s through 1983 have generated data with substantial multi-hazard use. The surveys have identified thousands of buildings that can be used for temporary lodging for people forced to leave their homes by various types of disasters. If a catastrophic earthquake hit the Los Angeles or San Francisco Bay areas, there would be damaged housing and utilities. It would likely be necessary to provide temporary lodging for many thousands of people for a considerable period of time after the earthquake. Such care for evacuees is of course an integral part of multi-hazard emergency planning, not solely applicable to a response to a nuclear attack.

These substantive modifications to the civil defense program in response to IEMS are not simply adding civil responsibilities on top of those for nuclear attack. While civil defense responsibilities have been broadened, so will the program benefit from the improved readiness of States and local governments to respond to natural and other domestic emergencies. State and local officials, emergency planners, police, fire fighters, health and welfare professionals who are preparing to respond to the most likely natural threats have a broadened responsibility to consider the full range of possible emergencies.

Senator Huddleston—Continued

POPULATION PROTECTION PLANNING

Question: Had the Washington State legislation opposing any type of planning to deal with the effects of nuclear attack not been vetoed, what specific activities that you are currently performing or supporting in Washington would have been prohibited?

Answer: Since the introduction of the Integrated Emergency Management System, which fosters generic planning for all hazards, there have been no unresolvable instances where a State or jurisdiction has prohibited any planning for nuclear attack.

When opposition to nuclear attack preparedness threatens the effectiveness of our existing program--Population Protection Planning--in a particular jurisdiction, we take steps to resolve the problem by negotiation and agreement. Each case is addresed on its individual merits. Full consideration is given to what a State and local jurisdiction is actually doing, rather than what is being said, and whether the actual work performed satisfies the requirements of our statutory responsibilities. We have not yet experienced a situation which required a cessation of any program activity.

FEDERAL PREPAREDNESS

Question:

Has FEMA been involved in any planning or training for potential emergencies at the summer Olympics?

Answer:

The FEMA has maintained liaison with the various agencies that are planning and preparing for various contingencies at the summer Olympics which might require Federal response. Through the Regional Office in San Francisco, FEMA is ensuring that Federal Preparedness efforts are being coordinated with the appropriate State of California officials and that responsibilities of the Governor for public health and safety are not being circumvented. A Federal Contingency Plan providing coordination guidance for potential emergencies requiring Federal assistance is being developed with the assistance of other Federal Departments and Agencies. This plan does not include law-enforcement/security emergencies which are addressed by DOJ/FBI.

Los Angeles Mayor Thomas Bradley and his City Department heads and emergency response staff attended an Emergency Management course at FEMA's Emergency Management Institute. This standard course included an exercise that addressed emergency situations such as electrical blackouts, mass medical casualties caused by heat stroke and smog, massive traffic jams, protest demonstration, etc., that might be faced during the Olympics.

TELECOMMUNICATIONS AND WARNING

Question: What has been the impact of the AT&T divestiture upon FEMA's telecommunications and warning systems?

Answer: The AT&T divestiture and general deregulation of the telephone industry will financially and administratively impact our present systems. The systems are almost totally dependent on leased communications facilities. These facilities are vulnerable in certain crises scenarios to failure, and are additionally subject to uncontrollable tariff increases and non-tariff pricing schemes. FEMA has an Interagency Support Agreement with the Department of the Army (DA). Currently, DA is identifying general tariff, non-tariff and rate changes applicable to our leased services. Until these rates can be identified, evaluated and approved in certain instances, we are without general knowledge of the dollar thresholds for our service requirements. The National Warning System (NAWAS), FEMA National Voice System (FNAVS), Interagency Communications System (ICS) and the Emergency Broadcast System (EBS) are under a limited waiver of FCC's Computer Inquiry II Decisions for Selected Command, Control and Communications Systems. This limited waiver is effective until 1 June 1984 for National Security/Emergency Preparedness services. It permits AT&T Communications to continue their role of providing an end-to-end operation, maintenance and management of these systems.

Question: Do telecommunications and warning systems have protection against electromagnetic pulse?

Answer: FEMA has taken measures to install shielded enclosures in approximately 35 States to primarily house Federally-owned or funded communications equipment. The signal lines, electrical power and coaxial antenna leads at these locations have protective devices. The six FEMA Federal Regional Centers (FRC's) have shielded enclosures and protective devices around communications equipment. Of these six FRC's, Region III FRC is completely electromagnetic pulse (EMP) protected.

FEMA is cognizant of the EMP threat and is continuing to provide protection to assure communications and warning capabilities in an EMP environment.

FEDERAL HOME LOAN BANK BOARD

STATEMENT OF EDWIN GRAY, CHAIRMAN

ACCOMPANIED BY:
MARY GRIGSBY, BOARD MEMBER
WILLIAM SCHILLING, DIRECTOR, EXAMINATIONS AND SUPERVISION
BOBBY HUGHES, DEPUTY DIRECTOR, FSLIC
ERIC HEMEL, DIRECTOR, POLICY AND ECONOMIC RESEARCH
SHANNON FAIRBANKS, EXECUTIVE STAFF DIRECTOR
NORMAN RAIDEN, GENERAL COUNSEL
FRANK HAAS, DIRECTOR, OFFICE OF DISTRICT BANKS
RICHARD PETROCCI, DIRECTOR OF ADMINISTRATION
DENNIS M. PITTMAN, BUDGET OFFICER

BUDGET REQUEST

Senator GARN. The second part of this hearing today is to hear the testimony on the budget request of the Federal Home Loan Bank Board.

Mr. Gray, I would like to welcome you to your second hearing before this subcommittee.

The Board receives no appropriated funds from the U.S. Treasury, rather the Congress provides a limitation on the administrative and nonadministrative expenses of the Board and the administrative expenses of the FSLIC.

This year your budget justification requests $24,381,000 and $41,704,000 for the administrative and nonadministrative expenses of the Board and $1,343,000 for FSLIC administrative expenses.

I see that you have a rather lengthy statement. I make the same request of you I made of the gentleman who testified before you, that you summarize your statement and we will be happy to put every word in the full testimony in the record.

Please proceed.

Mr. GRAY. Thank you very much, Mr. Chairman.

I appreciate the opportunity to appear here today to discuss the Bank Board's budget request for fiscal year 1985.

INTRODUCTION OF ASSOCIATES

Before proceeding I would like to introduce the members of the senior staff of the Bank Board. To my left and to your right the Budget Officer, Dennis Pittman; the Director of Administration, Mr. Richard Petrocci; Director of the Office of District Banks, Frank Haas; General Counsel, Mr. Norman Raiden; Chief of Staff, Executive Staff Director, Shannon Fairbanks; our newest member from Texas, Mary Grigsby;

William Schilling, who is the Director of Examinations and Supervision; Bobby Hughes, who is the Deputy Director of the FSLIC; and Eric Hemel, who is the Director of Policy and Economic Research.

OPENING STATEMENT

Our 1985 request of $67,428,000 represented a slight decrease from our 1984 budget. Because the agency must cope with unforeseen and alarming asset quality problems of many institutions that are now coming to light, our initial budget request proves to have been insufficient. I will comment further on this later in my statement.

The primary areas I would like to focus on today are the status of the thrift industry in 1983, the status of the FSLIC fund, and the need to increase our currently authorized level of examiners in the field.

ECONOMIC UPDATE

The overall health of the thrift industry improved slightly last year, primarily because of sharply lower market interest rates, but thrifts remain in a very fragile transition and face a long, arduous, and uphill road to recovery. The threat of future interest rate swings is a very real sword of Damocles poised over the industry and survival is by no means certain.

FSLIC-insured institutions had net after-tax income of about $2 billion in 1983, compared to the $1.1 billion loss a year earlier and the record $1.7 billion loss in 1981. Last year's profits represented a return on assets of about one-quarter of 1 percent. This is the best since 1980, but it is still far below profitability in the 1960's and 1970's.

The net worth position of FSLIC-insured institutions also improved moderately last year following 3 years of deterioration. The ratio of regulatory net worth to total assets rose from 3.68 percent at the end of 1982 to 4.03 percent last December. Even so, the net worth ratio remained 1.5 percentage points below the level of the late 1970's and was even further below earlier levels.

Moreover, if the special accounting procedures currently permitted were eliminated, the industry's profitability and net worth would be vastly less than what is reported for 1983. In other words, these special accounting prodedures have resulted in the reporting of thrift industry profits and net worth which have vastly overstated the actual operating profits and real net worth of the industry. Even with the use of such accounting procedures, 3.5 out of 10 FSLIC-insured institutions were still in the red in 1983, and more than 1 out of 4 such institutions had a ratio of regulatory net worth to total assets of less than 3 percent.

Net new deposit receipts of FSLIC-insured associations totaled a record $63.1 billion last year, which allowed them to make a record $138.2 billion of mortgage loans. This is an all-time record. During the course of the year, the FSLIC- insured institutions—over which we exercise responsibility—took steps toward improving their asset-liability match by increasing the ratio of mortgages made with adjustable interest rates. The share of such loans in total conventional home mortgage lending rose from a low of 26 percent in May, when I became Chairman, to 63 percent in December 1983.

STATUS OF FSLIC FUND

The difficult and fragile transition which thrifts now face does have profound implications for the FSLIC fund. The fund is already under enormous stress due to the thrift earnings crisis of the 1980–82 period and, absent strong remedial action, we foresee additional strains resulting from asset problems related to deregulation and access to brokered money insured by the FSLIC.

The size of the FSLIC insurance fund, which is $6.3 billion, represents a ratio of FSLIC reserves to insured deposits which is approaching an historic low point. The ratio has deteriorated steadily, from a level of 2 percent in 1970 to around 1 percent today. In fact, the current reserve ratio is approaching the range which prompted Congress back in 1962 to impose a costly secondary reserve additional assessment premium on FSLIC-insured institutions. However, in 1962 the industry's ratio of real net worth to assets was in excess of 7 percent. I want to point out that real net worth to assets was rather more and today, as I have mentioned, that ratio is vastly overstated by the use of special accounting procedures and, even so, it stands at only 4.03 percent.

The industry's depleted net worth reflects the devastating effects of interest rate spirals over the last several years, which in turn resulted directly from the gaping asset-liability mismatches that pervaded the thrift industry. Managers today have just begun the task of restructuring their portfolios—with the vital supplements provided by the Garn-St Germain Act—to avoid the huge maturity mismatches that nearly drove the industry to disaster in 1981–82. A significant upward swell in interest rates would again submerge the majority of thrifts in a sea of red ink, and the ability of the thrift industry—and the FSLIC—to absorb such losses would be highly debatable at best.

Even without a significant increase in interest rates, the emerging problems confronted by the FSLIC as a result of deregulation and the growth of federally insured brokered deposits make it likely that the current ratio of FSLIC reserves to insured deposits will drop further in the future. Since December 31, 1980, the FSLIC has expended almost all income received to solve problem cases, so that the fund is approximately the same size as it was 3 years ago, but at the same time total deposits have increased from $501 billion to $671 billion on December 31, 1983.

We also project that loss reserves that will be established for payment of insurance—liquidations—and future commitments on assisted mergers or acquisitions will create losses in 1984 that will cause reserves of the $6.3 billion insurance fund to decrease by the end of fiscal year 1984 and, perhaps, very significantly.

The problem caseload of both the FSLIC and the Office of Examinations and Supervision remained at a very high level during 1983. And while the number of resolved FSLIC problem cases decreased from 78 in 1982 to 47 in 1983, the volume of assets and complexity represented in the 1983 cases increased significantly. Perhaps most alarming, as we moved through 1983, the FSLIC problem caseload began to reflect more serious asset quality problems, rather than the negative spread problems which accounted for the majority of problem cases in the period between 1980 and 1982.

ASSET QUALITY PROBLEMS

The asset quality problems of 1983, and right through to the present, are larger and more severe than those the FSLIC faced in the late 1960's because of the rapid growth made possible by deregulation of liabilities and, in that connection, the availability of insured brokered deposits. Aggressive State actions to permit State-chartered thrifts to engage in a wide array of nontraditional activities necessarily creates a much more volatile risk-exposure climate for the FSLIC, and thrifts which use their new powers unwisely have been able to access and use brokered funds to grow from small problems into large ones virtually overnight.

The *Empire Savings & Loan* case in Mesquite, Tex., closed by the FSLIC, displays an increasingly typical pattern of irresponsible growth made possible through brokered funds and the massive asset quality problems which arise from unwise investment of deposits vastly augmented over a short period of time. The FSLIC anticipates paying out approximately $296 million on Empire's insured deposits, on which it now projects a loss to the FSLIC fund of $164 million.

While the Board has acted on a final rule to control the abuses associated with brokered funds, the long-term impact of these abuses on the FSLIC fund should, nevertheless, not be minimized. In the thrift industry, from January 1982 to December 1983, brokered funds placed in FSLIC-insured institutions increased tenfold from about $3 billion to almost $30 billion in just 2 years.

There is a significant correlation between associations using brokered funds and those which are supervisory problems. In 1982 and 1983, more than half of the insured institutions that were closed by the FSLIC had brokered funds in excess of one-third of their deposits. Almost half of the institutions with a net worth below acceptable levels have brokered deposits in excess of 20 percent of their total deposits.

The FSLIC expects its caseload over the next several years to be made up of institutions suffering from loan losses due to unsafe and unsound lending practices, with fewer cases reflecting losses due to negative spreads. Projections of caseload increases due to negative spreads are easier to make than those attributable to asset quality problems because negative spreads are directly tied to increases in the interest rate level. Detection of asset quality problems, on the other hand, requires frequent on-site examinations, which puts an increased burden on the examination staff.

NEED FOR ADDITIONAL S&L EXAMINERS

The alarming asset quality problems of many institutions now coming to light render our currently authorized level of examiner resources inadequate. The Board must increase its examination staffing to address the increased risk exposure resulting from rapid growth in an increasingly complex environment where funds are being deployed in unaccustomed ways. On-site examination is essential to assure prudent use of these new authorities.

One important reason the Board needs to add field examiners is to conduct such on-site examination for State-chartered institutions insured by the FSLIC. Moreover, I believe that States which enlarge thrift powers for State-chartered thrifts beyond those permitted federally chartered thrifts or which are chartering more thrifts should proportionally increase their own regulatory and examining efforts.

At the present time, the three banking agencies, taken together, average approximately 3.2 institutions per examiner, while the Board at current authorized strength averages almost 4.2 institutions per examiner. In this regard, we have received approval from OMB to request a change in our fiscal year 1985 budget submission which would increase our fiscal year 1985 employment for field examiners and related funding. Our request to add 37 Board examiners would decrease this average to 4.03, still above the current level of the banking agencies on a consolidated basis but slightly improved from the present.

BUDGET AMENDMENT

OMB approval of our proposal for 37 additional field examiners for fiscal year 1985 increases our budget request for field examiner staffing from 860 to 897 full-time equivalent positions at an added cost of $1,480,000. This amended nonadministrative expense limitation increases the Board's total fiscal year 1985 budget request to $68,908,000. OMB will be transmitting this budget amendment to the Congress.

In summary, Mr. Chairman, thrifts remain in an extremely delicate transition, terribly vulnerable to interest rate swings. Old problems could reassert themselves, and there are new difficulties to replace the old. Restructuring is still in its infancy, and there is still much to do before we can resolve the industry's major problems and achieve stability.

The uphill road to recovery is long and very hard, very tough, especially if interest rates move uphill also. This Board is doing everything it can to help make possible the survival of the savings and loan industry. Providing the Bank Board with sufficient budget flexibility is an appropriate means of meeting this time of change, opportunity, and responsibility.

PREPARED STATEMENT

That concludes my oral statement, Mr. Chairman. Allow me at this time to submit my prepared statement, after which my staff and I would be happy to respond to any questions you may have.

[The statement follows:]

STATEMENT OF EDWIN J. GRAY

Mr. Chairman, Members of the Subcommittee, I appreciate the opportunity to appear before you today to present the fiscal year 1985 budget request of the Federal Home Loan Bank Board. Our 1985 request of $67,428,000 represented a slight decrease from our 1984 budget of $67,635,000. However, because of the unforeseen and alarming asset quality problems of many savings institutions which are now coming to light, our initial budget request will be insufficient to enable the agency to cope with these problems. I will comment further on this later in my statement.

To assist the Subcommittee in its policy oversight function, my statement will also deal with (1) the economic status of the thrift industry in 1983; (2) the status of the Federal Savings and Loan Insurance Corporation ("FSLIC") fund; (3) the performance and supervisory actions of the FSLIC; (4) the Board's perspective on legislative initiatives currently before the Congress in the context of the Garn-St Germain Act; (5) the Board's regulatory activities; (6) the Board's restructuring initiatives; (7) the development of improved supervisory monitoring procedures and examiner training; and (8) the Board's equal employment efforts.

STATUS OF THE THRIFT INDUSTRY DURING 1983

The overall health of the thrift industry improved slightly last year, primarily because of sharply lower market interest rates. However, thrifts remain in a very fragile condition and face a long and arduous road to recovery. The threat of future interest rate swings is a very real Sword of Damocles poised over the industry, and survival is by no means assured.

FSLIC-insured institutions had net after-tax income of about $2.0 billion in 1983, in sharp contrast to the $1.1 billion loss a year earlier and the record $1.7 billion loss in 1981. Last year's profits represented a return on assets of about 0.27 percent; this was the best since 1980, but well below profitability in the 1960s and 1970s. Return on assets was slightly lower in the second half of 1983 than in the first half (see chart 1), reflecting primarily reduced profits on the sale of assets. In addition, 3.5 out of every 10 FSLIC-insured institutions were still in the red in 1983. This was better than the 74 percent of institutions experiencing losses in 1982, but it represents a stark contrast to the pre-1980 period when less than 5 percent of all institutions had losses in most years.

Moreover, most profits last year represented unusual nonoperating income. If the special accounting procedures currently permitted were eliminated, the industry's net worth would be vastly less than what is reported. In other words, these special accounting procedures have resulted in the reporting of thrift industry profits and net worth which have vastly overstated the actual operating profits of the industry.

Net operating income after cost of funds was negative in the first half of 1983, but turned moderately positive in the last six months, as gross operating income rose more than did the cost of funds (see chart 2). The gross return on industry assets last year was about 10.93 percent, up moderately from 10.82 percent in 1982, while cost of funds declined from 11.38 percent to 9.83 percent because of the sharp drop in short-term market interest rates.

The net worth position of FSLIC-insured institutions improved last year following three years of deterioration, with the ratio of regulatory net worth to total assets rising only moderately from 3.68 percent at the end of 1982 to 4.03 percent last December. Even so, the net worth ratio remained 1-1/2 percentage points below the level of the late 1970s (see chart 3) and was even further below earlier levels.

A large portion of last year's rise in net worth reflected the approximately $2.7 billion of stock sold as a result of the conversion of 79 institutions from mutual to stock form of organization. The rise in net worth also reflected improved earnings, other sales of stock, appraised equity capital resulting from new appraisals of the value of the fixed assets of institutions as provided for by a regulatory change made in 1982, and capital assistance from the FSLIC, primarily in the form of net worth certificates issued in exchange for FSLIC notes in accordance with the provisions of the Garn-St Germain Act. Again, it is important to note that "real" net worth is substantially lower than the reported figure due to the inflated profits which resulted from special accounting procedures.

And even with the use of such accounting procedures, more than one-fourth of all FSLIC-insured institutions had a ratio of regulatory net worth to total assets of less than 3 percent at the end of 1983.

Net new deposit receipts of FSLIC-insured associations totaled a record $63.2 billion last year, in sharp contrast to the net withdrawals experienced in 1981 and 1982 (see chart 4). This reflected both the lower level of market interest rates and the elimination of regulatory ceilings on most types of deposits, which permitted thrifts to compete more effectively for funds. Much of last year's deposit inflow, however, represented either a single-time shift of funds or relatively high-cost money. Early in the year, for example, most deposit growth was in the newly authorized money market deposit accounts, as institutions attracted funds from money market mutual funds and the securities market. Later, growth was concentrated in large-denomination accounts, especially broker-originated deposits, which increased from $9.3 billion, or 1.7 percent of deposits, at the end of 1982 to about $28.8 billion, or 4.3 percent of deposits, at year-end 1983.

The large deposit inflow to thrifts last year allowed them to make a record $138.2 billion of mortgage loans. This was well above the previous peak of $108.3 billion reached in 1978 and 2-1/2 times the amount of mortgages closed in 1982. Lending volume rose throughout 1983 and reached a peak, on a seasonally adjusted basis, in January of this year, the most recent month for which data are available (see chart 5). During the course of the year FSLIC-insured institutions improved their asset-liability match by increasing the proportion of mortgages made with adjustable interest rates. The share of such loans in total conventional home mortgage lending rose from a low of 26 percent in May to 63 percent in December (see chart 6).

As a result of lower interest rates last year, merger activity slowed from the record 1982 pace, although it remained high by pre-1980 standards. In 1983, the Bank Board approved 138 mergers, resulting in the disappearance of 159 institutions, whereas it had approved a record 425 mergers (483 disappearing institutions) in 1982. Of the mergers approved last year, 23 were FSLIC-assisted, down from 44 in 1982; 31 were of a supervisory nature but without assistance, down from 166 in 1982; and 84 were voluntary, down from 215 in 1982 (see chart 7).

STATUS OF THE FSLIC FUND

The difficult and fragile transition which thrifts now face has profound implications for the FSLIC fund. The fund is already under enormous stress due to the thrift earnings crisis of the 1980-82 period, and absent strong remedial action, we foresee additional strains resulting from asset problems related to deregulation and unlimited access to brokered money.

The size of the FSLIC insurance fund--$6.3 billion--now represents a ratio of FSLIC reserves to insured deposits which is approaching an historic low point. The ratio has deteriorated steadily, from a level of 2 percent in 1970 to around 1 percent today. In fact, the current reserve ratio is approaching the range which prompted Congress in 1962 to impose a costly secondary reserve additional assessment premium on FSLIC-insured institutions. However, in 1962 the industry's ratio of real net worth to assets was 7.04 percent. Today, that ratio stands at only 4.03 percent, and it represents a vast overstatement of real capital reserves due to special accounting procedures currently permitted.

The devastating effects of interest rate spirals over the last several years were the direct result of the asset-liability mismatches that pervaded the thrift industry. By August of 1982, 53 percent of the industry's interest bearing liabilities were in market rate instruments with an initial maturity of one year or less. On the other hand, 85 percent of the industry's interest bearing assets were in long-term, fixed rate loans. Industry managers have just begun the task of restructuring their portfolios--with the vital supplements provided by the Garn-St Germain Act--to avoid the huge maturity mismatches which nearly drove the industry to disaster in 1981-82.

As I noted earlier, the improvements in industry health last year were primarily the result of falling interest rates in conjunction with accounting devices which greatly exaggerated actual operating profits. And 35 percent of all FSLIC-insured institutions were still in the red. A significant upward change in interest rates could again submerge the majority of thrifts in a sea of red ink, and the ability of the thrift industry—and the FSLIC—to absorb such losses would be highly debatable at best.

Even without a significant increase in interest rates, the emerging problems confronted by the FSLIC as a result of the growth of federally insured brokered deposits make it likely that the current ratio of FSLIC reserves to insured deposits will drop further in the future. Since December 31, 1980, almost all income received by the FSLIC has been expended to solve problem cases, so that the fund is approximately the same size as it was three years ago. But at the same time, total deposits have increased from $501 billion to $671 billion on December 31, 1983. We believe that projected revenues are adequate to cover necessary cash expenditures for liquidations and supervisory mergers currently projected for 1984. We project, however, that loss reserves that will be established for payment of insurance (liquidations) and future commitments on assisted mergers or acquisitions will significantly impact the $6.3 billion insurance fund. While it is very difficult to project FSLIC reserve levels at the end of 1984, caseload trends suggest at least the possibility that such levels could be diminished, perhaps significantly.

SUPERVISORY ACTIVITIES

During calendar year 1983 the Bank Board approved 22 assisted mergers and 10 assisted holding company and private investor acquisitions involving 47 insolvent institutions having assets in excess of $17 billion. The present value cost of these transactions to the FSLIC approximates $935 million over a five- to ten-year period.

Also in 1983, six institutions required the appointment of the FSLIC as receiver for the purposes of liquidation due to the deteriorated state of their financial conditions or the lack of available resolution options. Savings deposits of more than $290 million, representing 32,000 insured accounts, were immediately transferred to other FSLIC-insured institutions. The transfer of insured accounts in this manner allows insured depositors access to their accounts with minimum disruption and also enables the FSLIC to obtain a premium from the institution assuming liability for the accounts. During 1983, the FSLIC obtained premiums of more than $5 million on the transfer of insured accounts to FSLIC-insured institutions.

Although economic conditions for the thrift industry improved slightly during 1983, the problem caseload of both the FSLIC and the Office of Examinations and Supervision remained at a very high level. Further, while the number of resolved FSLIC problem cases (not including cases involving the appointment of the FSLIC as receiver for the purposes of liquidation) decreased from 78 in 1982 to 47 in 1983, the volume of assets represented in the 1983 cases and their complexity increased significantly.

In 1980-82, the majority of FSLIC problem cases involved negative spreads, i.e., the excess cost of liabilities over earnings on assets, which generated operating losses resulting in insolvency. However, during the first quarter of 1983, the problem of negative spread began to ease as the reduction in the interest rate level was reflected in earnings statements. It was at this time--when the adverse effects of deregulation began to be felt in the industry—that serious asset quality problems began to emerge in the FSLIC caseload.

The FSLIC also confronted asset quality problems in the late 1960s immediately after a period of high interest rates. The asset quality problems of that period were generally confined to smaller institutions. The asset quality problems of 1983, however, are larger and more severe because of the deregulation of the financial services industry. The availability of brokered deposits now enables a small problem institution to grow into a large one virtually overnight. For example, an institution in Texas with total assets of $86 million as of June 30, 1982, grew to an institution with assets of $756 million as of December 31, 1983, through the solicitation of brokered deposits. Jumbo certificates of deposit--the vast majority supplied by brokers—made up 86 percent of that institution's augmented savings base. These funds were not invested in sound loans, resulting in a large institution with massive asset quality problems.

The case of Empire Savings and Loan Association in Mesquite, Texas, recently closed by the FSLIC, also displays the pattern of irresponsible growth made possible through brokered funds and the massive asset quality problems which arise from unwise investment of deposits vastly augmented over a short period of time. The FSLIC anticipates paying out approximately $296 million on insured deposits, on which it projects that the insurance fund will absorb a loss of $164 million. Approximately 85 percent of savings deposits in Empire represented third-party originated brokered funds.

The FSLIC expects its caseload over the next several years to be made up of institutions suffering from loan losses due to unsafe and unsound lending practices, with fewer cases reflecting losses due to negative spreads. Projections of caseload increases due to negative spreads are easier to make than those attributable to asset quality problems because negative spreads are directly tied to increases in the interest rate level. Detection of asset quality problems, on the other hand, requires frequent on-site examinations, which puts an increased burden on the examination staff.

Asset quality problems also tend to occur on short notice, especially where the institution misuses easy access to brokered deposits to grow faster than sound lending practices allow. The failure of Empire Savings and Loan Association in Mesquite, Texas, is a classic example of speculative and imprudent lending leaving the FSLIC with an extremely complicated and costly problem to resolve.

An unexpected asset quality failure like Empire leaves the FSLIC with a large operating entity and hundreds of millions of dollars of assets to manage, assess, and liquidate. The number of liquidating receiverships has increased ten-fold over the past 18 months, creating an urgent need for an upgraded and expanded marketing and management program of FSLIC receivership assets.

LEGISLATIVE DEVELOPMENTS

The most essential tool given the thrift industry in terms of providing long overdue flexibility and the ability to respond to rapidly changing economic conditions was the enactment of the Garn-St Germain Depository Institutions Act of 1982. The Act provided thrifts with sorely needed, albeit limited, new lending authorities to ensure thrifts the ability to generate contra-cyclical income, market rate deposit instruments to ensure efficient access to consumer funds, and net worth certificates to provide assistance in the short run to ailing associations. The Act expressly recognized that these new powers were vital to revitalize and strengthen thrifts' ability to continue their preeminent and unique home finance function.

In the year and a half since passage of the Garn-St Germain Act, a number of legislative proposals have been introduced to reform the current regulatory structure for banks and thrifts. While I believe the debate on financial services reform is healthy and timely, the Board is gravely concerned that certain of these proposals would totally undermine the primary goals of the Garn-St Germain Act by depriving thrifts of critical supplementary sources of capital and income. We are particularly troubled by proposals which effectively straitjacket thrifts' profit opportunities by forcing them into the regulatory mode designed for commercial banks. And the Board emphatically rejects the contention that such reforms are justified because the Garn-St Germain Act somehow magically transformed thrifts into banks.

In our view, any legislation which reforms the current regulatory structure for insured depository institutions must be guided by four basic principles.

First, any such legislation must acknowledge the very basic differences, in statutory authority and function, between thrifts and banks. Any objective look at what Congress actually said about its intent, the limited scope of the Act, and what thrifts have done since its passage proves beyond any doubt that there are vast differences in the mission and function of the two industries.

Most significantly, the Preamble to the Act clearly states its intent "to revitalize the housing industry, by strengthening the financial stability of home mortgage lending institutions and insuring the availability of mortgage loans" (emphasis added). This language demonstrates Congress' intent to ensure that federally chartered thrifts would in the future have the supplementary authority and diversification options necessary to cope with future periods of economic instability and interest rate volatility in order to continue to carry out their principal housing finance function.

This unique mission, recognized by the Garn-St Germain Act, contrasts dramatically with the principal mission of commercial banks to extend credit to corporate borrowers. And while the Act did enable federal thrifts to involve themselves in a very limited way in commercial lending, it also contained a qualifying assets test for "thriftness." That test strongly emphasizes a commitment to real estate and housing finance as a condition for certain branching rights and affiliation with diversified unitary holding companies. Special tax provisions also provide strong incentives to the thrifts to continue their home mortgage lending activities.

Our figures on how thrifts have used their new asset powers demonstrate very forcefully that they are generally proceeding in a very cautious, prudent way to supplement their traditional home loan activity. While the volume of nonmortgage lending increased substantially in many categories in the 18 months since the Act's passage, the percent of change as a fraction of total assets was miniscule. All types of nonmortgage loan investments affected by the new legislation comprised 0.7 percent of total assets in June 1982. In December 1983, the figure increased to only 1.7 percent of total assets.

Our data also demonstrate that most FSLIC-insured thrifts have maintained their traditional commitment to housing finance. As of June 1983, FSLIC-insured thrifts maintained more than 80 percent of assets in qualifying home loans and related assets under the tax code, far above the 60 percent minimum needed to justify diversified unitary ownership under the Garn-St Germain Act. Moreover, FSLIC-insured savings and loans made over $100 billion in residential mortgage loans in 1983, more than two and one half times the level for the same period in 1982, and an all-time record.

Second, any reform proposal must preserve and enhance, not reduce, the attractiveness of the thrift charter, to encourage the flow of new capital into the industry. We would strongly oppose any proposed attempt to force housing lenders into a structure designed for banks because it could cripple the financial recovery of the industry for several reasons. First, such an attempt would reduce profit-generating service corporation activities permitted for federal thrifts, thus stripping them of income and creating disincentives for mutuals to convert to stock form. Second, such proposals could deprive thrifts of the flexibility, diversity, and potential capital base afforded under the unitary holding company structure by reducing the types of entities permitted to own thrifts, while expanding the types of entities permitted to own banks. Finally, any attempt to scale back the structural options and activities for thrifts would badly tarnish the luster of the thrift charter in the capital markets. Thus, current "homogenizing" proposals would inhibit the flow of new capital into the thrift industry at a time when its need for new capital is most critical.

In a similar vein, any proposal which seeks to distinguish banks from housing lenders entitled to remain within the thrift regulatory structure must preserve thrifts' primary housing mission without reducing investment flexibility which is crucial to thrifts' ability to restructure their portfolios to meet their housing finance responsibilities to the American people. In our view, the most appropriate basis for such a legislative benchmark is a housing-based asset test which reinforces the fundamental differences between banks and thrifts. Such a test should foster industry revitalization by including a list of qualifying assets which includes all the basic items now included in the I.R.C. laundry list linked to unitary diversification under the Garn-St Germain Act. In addition, the test should recognize the housing-related nature of all private mortgage-backed securities, loans for home equipping and improvement and shelter for the aged and students, and investments in subsidiaries with housing-related assets. Such an appropriate asset test is especially important given the weakened condition of the industry and its continuing sensitivity to interest rate changes.

Third, any reform proposal should reaffirm the long-standing Congressional commitment to preserve an independent regulatory and deposit insurance framework for housing oriented lenders, with regulatory power over such lenders and their holding companies vested exclusively in the Bank Board.

Finally, we believe that an express ban on combinations of thrifts with underwriters and market makers of general corporate securities is vital to preserve thrifts' ability to carry out their housing mission and to prevent unique risks and potential conflicts of interest which could result from such affiliations.

BANK BOARD REGULATORY INITIATIVES

While the Board devoted most of its efforts to deregulation in 1983, circumstances have recently required it to exercise its regulatory authority by approving a final rule limiting the insurance coverage afforded to deposits placed by or through a broker with a federally insured savings association, by updating its policies relating to the approval of insurance applications of de novo institutions, and by proposing to amend its minimum net worth requirements for all insured institutions.

With the Federal Deposit Insurance Corporation ("FDIC"), the Board on March 26 unanimously voted to amend the agencies' regulations to limit the insurance coverage afforded to deposits placed by or through a broker with an insured bank or savings association. The Board also adopted a related interim final regulation which prohibits institutions having a net worth of less than 3 percent from accepting brokered deposits in excess of 5 percent of their total deposits. The interim final rule is intended to prevent institutions from loading up brokered deposits during the phase-in period from March 26 to October 1, 1984. The agencies took this regulatory action because deposit brokerage enables federally insured institutions to rapidly attract large volumes of funds from outside their natural market areas irrespective of their managerial and financial characteristics. Deposit brokering can in some circumstances provide a helpful source of liquidity to institutions. However, the ability of brokers to obtain complete insurance coverage through the parcelling of funds reduces market discipline by eliminating any incentive to analyze the financial health of recipient institutions. This fact has allowed poorly managed institutions to continue operating with brokered deposits beyond the time when natural market forces would otherwise have caused their failure. In effect, access to these brokered funds is a form of artificial life support which ultimately increases the costs to the FSLIC and FDIC through larger insurance payouts or higher assistance expenditures.

The statistics illustrating the magnitude of this problem are anything but dry. The 77 commercial banks that failed in 1982 and 1983 had substantial brokered deposits. In the thrift industry, from January 1982 to December 1983, brokered funds placed in FSLIC-insured institutions increased tenfold from about $3 billion to almost $30 billion. By the end of 1983, brokered funds accounted for only 4.3 percent of all savings and loan liabilities, but there is a significant correlation between associations which use brokered deposits and those which are supervisory problems. In 1982 and 1983, more than half of the insured institutions that were closed by the FSLIC had brokered funds in excess of one-third of their deposits. Almost half of the institutions with a net worth below acceptable levels have brokered deposits in excess of 20 percent of their total deposits. A total of 369 FSLIC-insured institutions (approximately one-tenth of the industry) hold brokered deposits in excess of 5 percent of total deposits, and of these 145 are troubled institutions. As I mentioned earlier, the brokered funds problem is urgent because of the additional stress it places upon the already strained FSLIC fund.

The new rule governing insurance applications of *de novo* institutions was designed to address a number of developments resulting in a dramatic increase in the risk of loss to the institutions themselves and, ultimately, to the FSLIC. In addition to the development of a nationwide brokerage network for the placing of insured deposits in savings institutions, these developments include a number of state statutes, enacted in response to the broadened investment powers that Garn-St Germain granted federal savings and loans, which provide enormously expanded asset powers to state thrifts. Finally, since 1981 all *de novo* institutions applying to the Board for insurance have been stock institutions. Under the old rule, these thrifts would have had an excessive ability to leverage liabilities.

To deal with this increased risk, the new regulation generally requires *de novo* applicants for insurance to raise initial capital of $3 million and to submit a 3-year business plan indicating an intention to invest not more than 10 percent of their assets in service corporation subsidiaries or in the acquisition of real estate. The rule also amended the statutory reserve and net worth requirements for *de novo* applicants for insurance to provide for increased reserve amounts and to delete provisions permitting the calculation of reserves on a 5-year-average basis and the building of reserves over a 20-year period.

The Board has continued to deal with this risk by proposing to amend its minimum net worth requirements applicable to all FSLIC-insured institutions. The proposed rule would gradually eliminate the required calculation of statutory reserves as a percentage of insured deposits in favor of the calculation of minimum net worth on the basis of total liabilities as a more reliable gauge of capital adequacy. The rule would impose a net worth requirement of at least 3 percent on any increase in liabilities after December 31, 1983, while gradually eliminating, over a five-year period, the currently permitted averaging and phase-in allowances for the existing liability base.

BANK BOARD RESTRUCTURING INITIATIVES

During the last year the Board also adopted regulations and policies significantly affecting the powers, capital formation, structure, and regulatory processing requirements of thrift institutions. These reforms reflect the overall goal of aiding industry restructuring to strengthen the industry's ability to carry out its home lending mission, and fall into five general categories: (1) changes to maximize the usefulness of new Garn-St Germain powers; (2) changes to streamline and modernize the applications process for changes in corporate structure; (3) the development of new tools by the Federal Home Loan Mortgage Corporation ("Freddie Mac") to aid asset-liability matching; (4) a new reporting system designed to aid the restructuring process; and (5) Bank System contributions.

1. Garn-St Germain Act Powers

While the most highly publicized new regulatory powers for federal associations were provided to implement the Garn-St Germain Act, which gave federals the authority to offer demand deposit accounts and commercial loans, Board regulations also addressed the thrifts' need for tools necessary to continue their commitment to housing. These tools were provided by enhancing commercial real estate and consumer lending authority. In support of the agency's commitment to assist the industry's housing mission, the Board substantially increased the investment authority of federals to provide maximum flexibility to structure loan terms and to make available comprehensive consumer disclosures of such terms. The Board also implemented new statutory authority providing for federal preemption of state due-on-sale restrictions. Other important investment powers granted to federals in the past year include authority for consumer leasing, liberalized manufactured home lending, and liquidity-eligible investments in debt securities hedged with certain forward commitments or futures, or held subject to options or redemption rights. The Board also permitted state chartered subsidiaries of savings and loan holding companies to invest in service corporations to the extent permitted by state law, rather than require them to comply with the federal association limits. Federal associations were also empowered to act as government depositories and fiscal agents, to engage in correspondent activities primarily with other depositories, and to participate in financial options trading.

2. Streamlining Corporate Reorganization

First, the Board has given highest priority attention to the mutual-to-stock conversion process. In the Board's view, conversion of thrifts from mutual to stock form of organization is the strongest structural alternative provided by the Garn-St Germain Act, not only because it gives thrifts greater freedom to choose their form of organization but also, and more importantly, because it enhances their capabilities to inject new capital into their operations. This, in turn, has the positive effect of simultaneously improving the institutions' net worth positions and buffering the FSLIC fund from further outlays and ultimate deterioration.

To that end the Board, in March 1983, substantially revised its conversion regulations to provide a speedier completion of the conversion process by permitting savings institutions that utilized the April 1982 subscription and public offering phases to dispense with the separate subscription offering and to give eligible subscribers the right to buy stock in the public offering on a priority basis. In addition, in June 1983 the Board adopted final regulations designed to streamline disclosure requirements by thrifts converting from mutual to stock form which, among other things, provided guidelines for financial disclosure, eliminated inconsistencies between Securities and Exchange Commission and Board regulations governing applications, and eliminated duplication of the same disclosure information in both the text and the footnotes of the application.

The Board is pleased to report that a substantial number of thrifts have availed themselves of the opportunity to restructure their form of organization and increase their activity to acquire new capital. As of December 30, 1983, 111 conversion applications had been filed with the Board, with 106 of these receiving approval. To date, 79 of the approved applicants have completed stock closings, yielding approximately $2.7 billion in new capital for the industry.

Because of the unprecedented surge in conversion activity, the Board has recently directed additional staff resources to the accounting and legal divisions to expedite the processing of applications. This will have the effect of substantially shortening the period needed to complete the accounting evaluation and legal review process.

The Board also substantially streamlined processing and paperwork requirements for mergers, trust powers, holding company acquisitions and debt incurrence, charter and bylaw changes for federal associations, charter conversions for supervisory purposes, and changes in corporate titles and office relocations. The Board also amended its accounting regulations to assist in the orderly restructuring of asset portfolios. The Board's branching policy statement was amended to address the complications of interstate branching after a supervisory merger, and explicit provision was made for branch offices acquired from a receiver of an insured institution and for sales of branches. The Board also provided for the organization, merger, acquisition, and expedited application processing of interim institutions and for the organization and chartering of de novo federal stock associations. The Board implemented new statutory provisions regarding grandfathering of state authority by institutions converting to federal charters, and it revised and simplified charter and bylaw adoption for federally chartered institutions. The regulations pertaining to notification of change in control of institutions were also substantially modified and updated. Finally, the Voluntary Assisted Merger Program was initiated and extended to expedite field processing of transactions involving FSLIC or supervisory problem cases.

The Board established a broader advances policy for the Federal Home Loan Banks enabling member institutions to obtain these funds with maturities up to 20 years. Longer term advances will assist thrifts in their efforts to reduce their interest rate risk exposure. In addition, the Federal Home Loan Bank System regulations were amended to provide for choice of membership in the case of interstate institutions.

Deregulation and paperwork-reduction efforts continued, with a change from monthly to quarterly financial reporting requirements and reduction of application-processing time. A major project during the year was adoption of comprehensive revisions to the Board's conflict-of-interest regulations to ease the industry's compliance burden and to expand legitimate business opportunities of insured institutions while maintaining sufficient supervisory tools to achieve regulatory objectives.

3. Freddie Mac's Enhanced Tools for Asset-Liability Matching

Third, the Board has worked closely with the Federal Home Loan Mortgage Corporation to fashion programs and initiatives intended to enable thrifts to restructure their portfolios in this interest-rate-sensitive environment to bring about a much closer asset-liability maturity match. Freddie Mac has introduced three new adjustable rate mortgages ("ARMs") purchase programs to supplement its continuing support for the fixed rate conventional mortgage market. Under these new ARMs programs, Freddie Mac will purchase 30-year term mortgages with rates and payments that adjust every one, three, or five years, based on the one-, three-, or five-year Treasury indexes. In addition, the one-, three-, and five-year ARMs are assumable and have a payment cap option available to the borrower to limit increases in mortgage payments.

It is our hope that Freddie Mac's ARMs program features will be attractive enough to encourage lenders to make adjustable rate mortgages. Freddie Mac has therefore added incentives for lenders who originate ARMs. First, Freddie Mac will buy the ARMs at lower prices, with the required margins on one-, three-, and five-year instruments being reduced to 100, 120, and 140 basis points, respectively. Second, for a limited time Freddie Mac will pay a development premium to lenders who originate and sell ARMs to the Corporation. Both the Board and Freddie Mac believe these incentives will encourage lenders to originate adjustable rate mortgages by creating a standard set of ARMs products and a more active secondary market and by increasing market acceptance of the mortgage instrument on a national level. The result of this effort should prove beneficial to borrowers as well as lenders.

Under the direction of the Bank Board, Freddie Mac has recently completed a national survey of lenders and realtors to obtain in-depth information on the extent and nature of current ARMs practices and acceptance in the housing market. This national survey will be supplemented by borrower focus groups to examine home buyer acceptance of these instruments. Our survey indicates that as lenders recover from the balance sheet buffeting they have experienced over the last few years, they are increasingly turning to interest-rate-sensitive assets, like ARMs, as a means of restructuring their portfolios. Additionally, as borrowers deal with an increasingly complex housing finance environment characterized by volatile interest rates, high house prices, and a myriad of different financing programs, they are beginning to realize the importance of having a choice between the standard fixed rate mortgage and the adjustable rate mortgage.

Freddie Mac initiated its survey of lender, realtor, and borrower attitudes in order to better structure ARM program characteristics to meet the needs of all participants in the primary housing marketplace. In this regard, Freddie Mac's ARM programs are being developed and refined through the feedback of lenders, realtors, and borrowers actively engaged in the home finance market. The development of "field tested" ARMs combined with efforts to broaden the understanding of lenders, realtors, and borrowers on the benefits of ARMs will assist all actors in the housing market and strengthen our thrift institutions by providing them with an important portfolio restructuring tool.

To ensure national use and acceptance of adjustable rate mortgages, Freddie Mac, in cooperation with the Federal National Mortgage Association, has also introduced uniform lending documents for adjustable rate mortgages with and without payment caps. These efforts were directed by the Bank Board in recognition of the critical importance of uniform mortgage documentation in ensuring national acceptance, understanding, and tradeability of standard mortgages. Ten years ago, Freddie Mac pioneered the effort to bring about the national standardization of fixed rate mortgages. The Bank Board believes that recent Freddie Mac efforts to provide the lending industry with nationally uniform ARMs documentation will result in a similar contribution and will further encourage the restructuring of thrift portfolios through ARMs.

Through Freddie Mac, the Bank Board will soon introduce another ARM purchase program specifically designed to assist thrift restructuring. Under this program, adjustments in the mortgage will be tied to a cost-of-funds index representing an institution's average cost of borrowings, bank advances, and savings. This program will permit thrift institutions both to originate and to buy ARMs tied to a cost-of-funds index.

In addition, Freddie Mac's collateralized mortgage obligations ("CMOs"), introduced in June 1983, have become another important element of thrift restructuring. The first two Freddie Mac CMOs were collateralized by new loans. Freddie Mac purchased more than $1.2 billion of fixed rate loans which were originated by thrift institutions. This innovation has allowed thrift institutions to meet their market demand for new fixed rate loans without jeopardizing their portfolios by retaining these loans. In addition, these institutions were able to further strengthen their investment positions by purchasing the first class of the CMOs, which have a maximum maturity of five years. As an investment vehicle, the CMO instrument has provided thrifts with a valuable option to invest in a short-term instrument specifically designed for thrift use in asset-liability management. Over 30 percent of the "fast pay" portion of the first two CMOs were purchased by thrift institutions.

A more recent innovation, made under the direction of the Bank Board, has resulted in a Freddie Mac CMO for below-market mortgages to provide an effective outlet for thrifts to sell their low yielding 30-year, fixed rate investments at the best possible price. This issue was backed by $525 million of mortgages purchased from thrift institutions with an average weighted interest rate of 9 percent. These institutions realized $10 million additional profits as a result of this CMO--profits they could not have realized through any other means.

When used to assist thrift institutions in restructuring their portfolios, the CMO is an extremely cost-effective vehicle to transfer below-market-yield interest rate risk to a broad private sector investor base, and thereby reduce enormously the interest rate risk shouldered by thrift institutions. The CMO concept, created and introduced by Freddie Mac, is now being used independently by some thrift institutions to sell their below-market mortgages at a better rate, thereby improving their profitability.

4. New Reporting System

Fourth, the most far-reaching initiative to assure the restructuring of the industry is the implementation of a new financial reporting system. Beginning the first quarter of 1984, every FSLIC-insured institution will report quarterly to the Board the maturity structure of its assets and liabilities. This new report will accomplish two objectives. First, every FSLIC-insured institution will have to examine its interest-rate-risk exposure. We believe the new reporting requirement is crucial to the survival of the industry, because recognition of a problem is the first step to its ultimate solution. Second, the Board will be able to monitor the industry's interest-rate-risk exposure and be better able to measure the impact of the initiatives I have discussed. In addition, the information from the new reporting system will enable the Board to take appropriate regulatory action in order to facilitate the continued restructuring of the industry.

5. Bank System Contributions

In recent months, the Board has also worked on several initiatives that will utilize the resources and expertise of the Federal Home Loan Banks ("Banks") to assist member thrift institutions. These initiatives will help members in their efforts to use the new powers granted by the Garn-St Germain Act and to restructure their portfolios to reduce their exposure to interest rate risk. Through these initiatives, the Board believes the Banks will play an effective role in providing thrift institutions with the tools necessary to assure the thrift industry's long-term viability and continued commitment to home finance.

The most important of these initiatives is the Board's recent adoption of policy guidelines which authorize the Banks to engage in interest rate swap transactions with members. An interest rate swap is an agreement between two parties to exchange fixed rate and variable rate payments for a specified period of time. An interest rate swap between a member institution and a Federal Home Loan Bank provides the member with an effective means of more closely matching its assets and liabilities, and thus is an important tool to reduce the institution's interest rate risk. The Board has provided the Banks with flexible guidelines which allow them to act as principals in swaps with members, to combine smaller members' swaps, and to issue standby letters of credit on behalf of member institutions. The Banks' participation in members' swap transactions will permit a greater number of thrift institutions, especially small ones, to benefit from this important financial tool.

The first interest rate swap was arranged on March 8, 1984, by the Federal Home Loan Bank of Seattle for $60 million in notional principal. To date, six Banks have developed interest rate swap programs that conform to the Board's policy guidelines. The Board expects that all Banks will have interest rate swap programs in place by mid-year.

Another service currently under study by the Federal Home Loan Banks is the development of computer-based simulation models that the Banks will make available to member institutions on a fee basis. These models will assist thrift managers in their decision-making by evaluating different investment and funding strategies and simulating future performance based on the institution's assumptions about future economic conditions. These models also will provide managers with a comprehensive analysis of their asset and liability structure in order to evaluate their exposure to interest rate risk. Our purpose in making these models available to member institutions is to assure that management of all thrifts, not just the larger institutions, has access to the sophisticated financial analyses necessary to make informed, prudent decisions.

A final area under review by the Board is the Banks' role as providers of educational seminars for members on the use of various asset-liability management tools and new asset-diversification techniques. To the extent practicable, the Federal Home Loan Banks will coordinate sponsorship of industry seminars through local, state, and national trade associations.

I think it is important to point out that, in all of the initiatives described above, the Board does not intend for the Federal Home Loan Banks to provide member institutions with advice or recommendations for specific transactions and strategies. Rather, it is our goal to assist thrift managers in obtaining the knowledge and skills that will enhance their decision-making abilities.

REVISION OF THE EXAMINATION PROCESS

In my statement on the fiscal year 1984 budget request, I described a pilot examination program designed to improve the quality and timeliness of our examination process. The results of that pilot program were positive and very encouraging. Accordingly, during October 1983, we expanded the activity to a full-scale test in the pilot district and three additional districts. Further expansion to an additional four districts will be accomplished by March 30, 1984, and by June 30, 1984, all twelve districts will be operating under the new program.

The revised examination process relies heavily on computer assisted reviews of association financial data permitting in-depth financial analysis now done on-site to be done in centralized locations. Through greater use of technology and more focused use of examiners, the Board's examination process will be able to identify more quickly and effectively emerging association financial problems. Equally important, Board examiners will be able to monitor, virtually continuously, the success of associations in restructuring their balance sheets by adopting Garn-St Germain powers.

We have learned, however, in the past few months particularly, that greater use of technology does not automatically decrease our staffing requirements for field examiners. In fact, in the light of recent experience, we are facing a potentially acute shortage of examiners. Our major concern is a growing asset quality problem, compounded in part by the injection of brokered savings into the financial system. Simply put, a large number of our institutions have taken in more funds than can be safely employed in prudent lending, resulting in growth which is almost uncontrollable. For example, during 1983 in our California district there were 16 institutions which grew from 26 percent to 187 percent per month. In the same district, 16 of the 19 new associations which opened during 1983 experienced over 400 percent growth during the year. As I have mentioned, we were forced to liquidate an institution recently because of poor loans which that institution funded largely through brokered deposits.

Our computer assisted examination process will permit us to track an institution's financial condition more effectively. However, it was not intended to permit examiners to review the quality of an association's loans—that has to be done on-site at the institution by both examiners and qualified Board appraisers. Increased examination staffing, including both field examiners and appraisal specialists, is needed to monitor and address the risks which these severe asset quality problems create for the insurance fund.

I should also point out that a number of states have enacted new nontraditional powers for state chartered institutions. Thus, we are facing not only rapid growth but an increasingly complex environment in which funds are being deployed in unaccustomed ways. On-site examination is essential to assure prudent use of these new authorities. One important reason the Board needs to add field examiners is to conduct such on-site examination for state chartered institutions insured by the FSLIC. Moreover, I believe that states which enlarge thrift powers for state chartered thrifts beyond those permitted federally chartered thrifts or which are chartering more thrifts should proportionally increase their own regulatory and examining efforts.

Finally, we are also seriously understaffed with respect to examinations of data processing operations in institutions. This is an area in which the Board lags behind the other federal financial regulatory agencies. Although a program has been designed to build expertise in this area, the fact is that the Board has no field personnel at the present time capable of carrying out an examination of association electronic data processing operations. Our plans call for hiring one electronic data processing specialist in each of the twelve examination districts.

At the present time, the three banking agencies, taken together, average approximately 3.2 institutions per examiner, while the Board at current authorized strength averages almost 4.2 institutions per examiner. In this regard, we have just received approval from the Office of Management and Budget ("OMB") to request a change in our fiscal year 1985 budget submission which would increase our fiscal year 1985 employment for field examiners and related funding. Our request to add 37 Board examiners would decrease this average to 4.03, still above the current level of the banking agencies on a consolidated basis but slightly improved.

EXAMINER TRAINING

The new asset powers authorized under the Garn-St Germain Act and the more complex financial transactions being conducted by the industry have required further expansion of the examiner training program during 1983 in order to maintain the Board's high examination standards. The Office of Examinations and Supervision conducted twice as many training sessions in 1983 as in 1982, training nearly 1,200 people.

Three new courses became fully operational during the year. Two of these courses were designed to increase the scope of our training effort beyond purely technical training to include analytical skills used to judge the safety and soundness of savings institutions. The curricula include asset and liability management, financial statement analysis, advanced accounting principles for specific industry problems, and the applications of analytical finance. The third new course, developed totally with in-house resources, deals in a highly technical way with various financial instruments and the futures and options markets.

A fourth course was developed and tested, and it will shortly become operational. It covers commercial lending and includes the risk-reward relationships associated with business lending and corporate finance, as well as credit management and monitoring.

The training career path begun in 1982 for all examiners during their first three years of service was expanded to include four separate courses. This multi-year scheduling of training and the modernization of the Office of Examinations and Supervision training operation through computerized scheduling and statistical analysis assisted in the expansion of our training effort with minimal resources.

The Bank Board's state training program achieved significant results in 1983. Twenty-two states now participate in the training career path, allowing their new examiners to be scheduled and trained in the same manner as federal examiners. Total state participation in career path training and other Bank Board courses resulted in training for 644 state examiners. The process of providing equal training to both state and federal examiners has progressed so well that during 1983 one state examiner served as an instructor at 50 percent of the training sessions conducted by the Board.

EQUAL EMPLOYMENT OPPORTUNITY EFFORTS

The Bank Board's hiring has been very limited since February 1983, the date of our last budget hearings. We have, however, significantly improved the employment of women in all occupations. Out of 32 hires at the GS-9 level and above in the headquarters permanent staff, 37.5 percent were women. Of the 23 limited-term positions established to handle the heavy work load associated with the problems in the savings and loan industry, 30.4 percent were women. Within these same two hiring categories, 6 percent and 4.3 percent respectively were minority hires. Retention of minorities previously hired has been excellent, and overall improvement is continuing. The increases in female employment this year were particularly encouraging since practically all hires were made in the legal and financial occupations, where women have been historically underrepresented both at the Bank Board and in the general work force.

During the past year, the Bank Board has seen an increase in the internal movement of its employees indicating that the specialized skills and knowledge of current employees are recognized as a valuable resource by agency managers. Out of the 18 higher-level professional and administrative positions filled through internal selection procedures, 44.4 percent were females and 11.1 percent were minorities. Much of this internal movement has resulted in increased representation of females in higher-level positions over the last year. In December 1981, 19.6 percent of the employees in headquarters positions at the GS-13 level and above were females, compared to their current representation of 25.8 percent. At the present time, female and minority representation in supervisory positions GS-13 and above is 31 percent and 16 percent, respectively. There are five females in senior management positions at the office director level or above, including the executive staff director.

The Board has realized an increase in minority representation at all grade levels in headquarters from 29 percent in December 1981 to a current level of 32 percent. We are continuing our emphasis on recruiting entry and mid-level female and minority candidates and providing increased opportunities for career progression.

As I indicated last year, the Bank Board anticipated that the administration of its own staffing program for its most populous occupational field, savings and loan examining, would help it achieve a larger percentage of female and minority employees at all levels of the Bank Board's work force in future years. The staffing program became fully operational in the summer of 1981. At that time, female and minority representation in the examiner occupation was 13.8 percent and 10.6 percent, respectively. Our current figures reflect a significant increase in female representation to 27.4 percent and in minority representation to 15.6 percent. We attribute this success to our extensive targeted recruitment activities since the establishment of the staffing program. During the period since the last budget testimony, eligible female and minority candidates comprised 38.5 percent of the applicant pool, but 44 percent of our 43 hires in the examiner field were females and minorities, including two Hispanic males and one Hispanic female.

Over the last few years, the Bank Board has increased minority and female representation in the examiner occupation in grade levels 13 through 15. From 1981 to the present, female representation has increased from 0.5 percent to 1.6 percent. Minority representation has increased from 2.9 percent to 3.8 percent. We realize that progress will be slow in narrowing the gap between average grade levels of white males and those of females and minorities, but we are confident that our success in hiring minorities and females at the entry level with an emphasis on career progression will provide a tremendous payoff in future years of increasing minority and female representation in supervisory and management positions. We feel this approach is the best way to achieve parity in our specialized occupations.

Although budget restrictions will significantly affect our hiring activity during the next fiscal year, we expect to continue our targeted recruitment activities at minority colleges, universities, and organizations nationwide in order to increase the number of minority candidates in our pool of eligible candidates for all occupational fields.

ADMINISTRATIVE AND NONADMINISTRATIVE EXPENSE LIMITATIONS

At the time of the President's submission of the fiscal year 1985 budget, the Bank Board requested authority to spend $67,428,000 in fiscal year 1985. Since then, the extent of the asset quality problems of many insured institutions has come to light. Detection of asset quality problems requires much more extensive on-site examination. Our currently authorized level of examiner resources is inadequate to meet this demand. As I have previously stated, the OMB has approved our proposal for 37 additional field examiners for fiscal year 1985. This increases our fiscal year 1985 budget request for field examiner staffing from 860 to 897 full-time equivalent positions at an added cost of $1,480,000. This amended nonadministrative expense limitation request increases the Board's total fiscal year 1985 budget request to $68,908,000. The OMB will be transmitting this budget amendment to the Congress.

In the administrative area, we are upgrading the importance of our headquarters staff's role of assisting the Board in its development of policy. At the same time, we are reducing the size of the Board's Washington staff to 475 full-time equivalent positions, as indicated in the budget justification. To this end, we are currently reviewing all functions performed by our Washington offices. Following this review, we will likely streamline our headquarters operations and delegate certain responsibilities to the Federal Home Loan Banks. In addition, we expect that the Bank's supervisory staffs will be increased to correct the existing problems of associations and to stem developing problems brought about by deregulation.

CONCLUSION

In summary, thrifts have experienced a slight recovery after a period of historic losses brought on by inflation and severe high short-term interest rates. However, the industry is in an extremely fragile transition and is terribly vulnerable to interest rate swings. Old problems could reassert themselves, and there are new difficulties to replace the old. In short, there is still much to do before we can resolve the major problems of thrifts and achieve stability within the industry. I am cautiously optimistic about the future of the savings and loan industry, and providing the Bank Board with sufficient budget flexibility is an appropriate means of meeting this time of change, opportunity, and responsibility.

This concludes my statement. My staff and I would be pleased to respond to any questions.

NONSUPERVISORY MERGERS

Senator GARN. Thank you, Mr. Gray.

Senator Abdnor, do you have any questions?

Senator ABDNOR. Thank you, Mr. Chairman.

Before I begin I would like to thank all of you from the Home Loan Bank Board for coming today. Because I think this is an area that strikes more than just South Dakota, I want to discuss what on the surface is a matter of concern to my State.

It is my understanding that the financial regulatory agencies are not approving nonsupervisory interstate mergers without congressional action. Is that true? Is that so?

Mr. GRAY. It has been long the policy of the Federal Home Loan Bank Board to observe what we believe has been the wish of the Congress or the sense of the Congress. We do approve mergers involving FSLIC assistance, FSLIC help across State lines.

Senator ABDNOR. I guess I should ask the chairman of the Banking Committee a question. Is there any reason why small savings and loans that will not grow into national financial institutions have to have congressional approval for two institutions to merge across State lines?

Senator GARN. I don't have my Banking Committee hat on today; that was yesterday.

Senator ABDNOR. Well, in South Dakota we have a situation where Dakota Savings & Loan in Sioux Falls which, as far as I know, is in quite decent financial shape, cannot take care of the demands and the needs of the Sioux Falls home loan demand.

At the same time, South Dakota is one of the States, along with about four or five, that have not enjoyed this great economic recovery. I know you can point to some States and say, "Oh, things are really moving." Yet we have people who would like to invest in homes but there is not enough capital available. They are people who are reliable borrowers, but this little Dakota Savings & Loan is not in a position to take care of all their needs. But to solve this problem, Dakota Savings & Loan has an opportunity to merge with a firm up in North Dakota by the name of Metropolitan Federal Savings & Loan. Metropolitan Federal Savings & Loan has some branches in North Dakota, is very successful, and would like to move into South Dakota and take over the Dakota Savings & Loan to meet Dakota Savings & Loan's excess home loan demand.

In the past, I have heard a lot of good things about deregulation. So far everything that has ever happened in deregulation has really taken care of small States. I watched it with the airlines, I have watched it with the trucking, the telephone now we are breaking it up—I assure you it is going to be another serious problem in rural America. Those S&L's that are trouble seem to be in great shape—you can supervise them, you let them merge, but an institution that is sound is not being allowed to merge to the benefit of the institutions, their stockholders, and, most importantly, their customers.

Senator GARN. I can't resist. South Dakota is doing more deregulating than I have ever imagined we would do at the national level.

Senator ABDNOR. I know, but that is another thing with banks and national banking. In this case here, we are talking about two small businesses who find it advantageous to combine assets to serve their present customers.

I am just wondering why it is that these S&L's are prevented from merging. You know, we are not going to have a big national banking company out of this, you are having a small acquisition that becomes 32 branches instead of 31.

INTERSTATE BRANCHING

Mr. GRAY. Well, I see some moves in the direction of exacerbating some term like chaos in the financial system. We have, as I say, tried to observe what we have believed. I believe over many, many years with the Federal Home Loan Bank Board with the sense of the Congress with respect to interstate branches. I know that the Congress this year is going to be, and is taking up this subject, that there is certainly a great deal of talk about interstate or regional interstate banking, reciprocal arrangements between States and the like. I have pointed out in my opening statement here today the difficulties that the FSLIC is faced with, Senator, and I have very real concerns strictly from my vantage point as the operating head of the FSLIC. I have concerns that moves, unless they are thoroughly thought out in the interstate banking, are going to make it more difficult for us to solve problem cases for the FSLIC.

In the last several years the FSLIC has saved $2 billion to the fund because we were able to use the supervisory arrangement to arrange for these kinds of mergers. In the absence of that, in the absence of there being any franchise value to a possible acquirer for an institution, if we were to unshackle what has been traditional in the banking industry in terms of the interstate branches, I simply do not know how we could possibly—as fiduciaries of the FSLIC I don't see how we could attempt to solve the problems.

Ms. FAIRBANKS. May I respond?

Senator ABDNOR. Keep in mind I am not talking about the huge mergers of billions of dollars. I am talking about an outfit with $70 million going in with this outfit of about a billion dollars. My State needs people who want to lend money; this is an operating concern. You can't tell the difference between North and South Dakota unless someone told you that you are crossing State lines. We are exactly alike.

I could understand your problem with mergers involving billions, but is there any law that says you cannot do this or is this just something you don't want to do? Tell me. Could you do it if you really wanted to?

Mr. GRAY. Well, I believe that we have the authority, have long had the authority to do this. My General Counsel would like to answer that question and I would defer to him.

Mr. RAIDEN. Senator, our regulations preclude interstate branching in the approval of mergers on an interstate basis on nonsupervisory cases.

We have had many protests and complaints in connection with interstate applications because of the concerns or disruption of local markets by out-of-State institutions moving in. If we were to change the regulations to permit general interstate branching, then, of course, we have a concern with the banking regulators having problems with the same thing since they are precluded from doing that by the MacFadden Act and the Douglas amendment. We have proposed regulations that would permit interstate branching where the States themselves allow it, but have not taken action on that because it has been a matter of great dispute.

Mr. GRAY. Simply in my mind as Chairman, it is a very substantial public policy issue that I think frankly ought to be addressed by the Congress before we move to establish a precedent. It would, in fact, be a precedent which would have very significant potential impact.

Senator ABDNOR. Let me ask you. Since you have started this so-called regulation, have you allowed any interstate merger regardless of how small and is there any case on record here with you of any place in the United States where you have allowed one little savings and loan to go into another one right across the line? I mean to your knowledge, has this been carte blanche?

Mr. RAIDEN. We know of none except on a supervisory basis.

Senator ABDNOR. Your Des Moines office thought it was a darn good deal out where they know what it means for a State to have this done and what it would do for our States, but it is hung up up here. I mean apparently you could do it if you wanted to do it.

NEED FOR CONGRESSIONAL ACTION

Senator GARN. If you would let me respond, I will put my other hat on for a minute.

Senator ABDNOR. All right.

Senator GARN. I have been a little bit involved in this process for 9 years of my life. Their hands are really tied, Jim. They get in trouble with a lot of people over setting those kinds of precedents. I understand what you are saying about North and South Dakota. There are natural marketing areas in this country where political boundaries have nothing to do with market areas. One of the most prominent is Washington, DC, and the Maryland and Virginia suburbs.

Several years ago there was a big dispute over whether the regulators would go ahead because there was a question of, where is the line—the Potomac River? I was part of that and said, "No, don't you do that"—not because it didn't make sense, but because Congress needs to make a decision. I have been trying to hammer my committee now to take an additional step in making some of these decisions and they will not do it, and under Garn-St. Germaine the only option they had were supervisory mergers.

Now interstate banking in reality is here. We have interstate loan generation offices that are legal, we have interstate trust operations that are legal, we have grandfathered institutions in the Midwest Bank

Corp., the First Interstate in 11 Western States. We have more and more States that are taking action all the time, including my own, which is violently opposed to interstate banking and just last week unanimously approved, in a special session unanimously in both the House and the Senate signed by the Governor of the State the same day, an interstate compact for 10 of their States, except California.

So Congress does need to act and these are decisions that we need to make. I would like them to do it right now. Last summer they wanted a moratorium on everything, 6 months, the same old rhetoric of: Will you please give us 6 months because these are decisions that have to be very carefully considered. Well, we didn't have a moratorium, but 10 months have passed and they still have not been willing, but now there is another argument we need a moratorium. That is a cop out.

You need to help me drive our colleages toward making some decisions on these issues, but in the absence of that, no matter how logical it may be, I would have to take the position that the Board is not following the law if they provide for an interstate merger that is not of a troubled institution and also say that I may agree with you, and there are a lot of these I would say where it makes absolute sense. It makes sense to cross Virginia, Maryland, and District of Columbia lines.

Utah is a natural market area. Salt Lake City for western Colorado, western Wyoming, southeastern Idaho, eastern Nevada, and the whole thing. It is a distribution center for all kinds of products, except financial products, but Congress has not made that decision and does not want to and we would run all over the Board if they—

Senator ABDNOR. Mr. Chairman, you are always very convincing.

Senator GARN. I have not been able to convince my colleagues that they should take the second step in deregulation, but I am still trying.

SUPERVISORY MERGERS

Mr. GRAY. Senator, if I may just add to that, I want to reemphasize a very deeply held concern I have, and I am sure my fellow Board members hold, with respect to the status of the FSLIC fund. In my opening statement I have already gone into the condition of the fund. I have talked about the condition of the industry, I have talked about the extremely fragile state of an $800 billion industry holding one-third of the assets of those assets within the aggregate by commercial banks in this country.

I must make everyone aware here that if we lose the opportunity through the supervisory authority that we have to bring about mergers and to provide for some franchise value and incentive for one institution to take a failing institution in another State—if we lose that opportunity, it is going to be extremely costly to this insurance fund, and we can't only talk about North and South Dakota, we are talking about 50 States. If that happens, I frankly have to say I do not know how we are going to be able to cope in managing the FSLIC and serving its resources irrespective of whatever public policy merits there may be with respect to interstate banking in general or regional interstate banking or whatever varieties or manifestations of that concept.

Senator ABDNOR. You speak of the supervisory programs, but some day when we do pass the legislation—and I hope in the near future—we are going to have to allow it anyway as a matter of fact.

Mr. GRAY. Even if we do that, in my mind we still have to deal with all the potential problems that the FSLIC is going to face as a result of that. That is a major policy change and it will have very significant impact on our ability to solve FSLIC problems and to conserve the resources of the FSLIC fund.

Senator ABDNOR. I guess you should write in some kind of a special provision for institutions with really small holdings, because in this case I know what you are saying, and I guess I have to agree to it. But when you have one in North Dakota being a little larger and one in South Dakota as far as I know in healthy condition but so small it can't take care of the needs of a city like Sioux Falls, there should be some special provisions that would allow others to come in and help us out. I guess this shows you what we can do in Government when things get screwed up. I hope I see some good in deregulation for rural America as well as the rest of the country.

Mr. GRAY. What we are faced with here—and I have said this before—is deregulation on the one hand of liabilities and assets and safety and soundness considerations as they relate directly to the deposit insurance funds. How that conflict, or at least is an apparent conflict—a real conflict to me—how that is reconciled and resolved is a public policy issue of the highest magnitude.

Senator ABDNOR. Well, thank you. You have been very kind.

Mr. GRAY. Thank you very much, Senator.

Senator ABDNOR. I appreciate it, Mr. Chairman.

LEGAL DIRECTION NEEDED FOR DEREGULATION

Senator GARN. I just would add one other comment, that the reason I push so hard for Commerce to take action, is that deregulation is a curious market, the real world is out there, it is going on, and it is a question of whether Congress is willing to deal with it in trying to set some policy guidelines for how it occurs or whether we just let it happen. It can happen through State legislatures, through the regulators being forced to take positions of one kind or another, because we will not get legal direction to follow.

I guarantee you, this is just like the experience with the NOW account. It tells you you did not have the authority to do that, therefore, we finally, after the fact, came back in March 1980 and said, "Yes, we will give it to you." Congress has always acted defensively after the fact to ratify something that has already taken place in the marketplace and I am trying to drive through that and say, "Hey, why are we so far behind, why don't we do it." The most frustrating experience I have had in Congress is trying to get them to recognize the real world and the delay only makes the decisions more difficult.

I am getting the same old stuff right now—we cannot do anything else this year, it is a Presidential election year. So what? What has that got to do with the price of eggs? I mean we don't need to pull the covers over our head and hide because there is an election year going on and it does not require a lot of time. These are the types of decisions that if I can put together another consensus, two hours on the floor will be enough. We waste more than that doing nothing over on the floor every single day. We can stay in session 10 or 12 hours as we did last night. I could have passed the whole deregulation bill while they were arguing about procedure last night.

Senator ABDNOR. That is right.

Senator GARN. So I need your help, Jim. [Laughter.]

Senator ABDNOR. Thank you very much.

Senator GARN. Thank you.

EXAMINER RESOURCES

You noted in your statement that your initial budget request would be inadequate and you noted that OMB is requesting 37 additional people. You also mentioned the 4.03 ratio of institutions per examiner. So even with the additional people, your ratio is going up in the wrong direction.

Do you feel that you can do an adequate examination job even with the proposed increase in staff?

Mr. GRAY. We certainly hope so, and if we at some future point in time in this very volatile environment that we are living in, if at some point in time we feel we can't, we will feel obligated to come back and ask for a supplemental. We asked OMB for 50 new examiner positions; we were given 37. We will just have to wait and see and hope that this does, in fact, enable us to do the job that we are supposed to do.

Senator GARN. You should feel grateful that Dave Stockman has a little bit of heart for you anyway. Most of the requests that go down there come back empty handed. Did you hit Dave on a weak day or a weak moment or something?

Mr. GRAY. We believe the new computer-based monitoring system that we have put into place will enable our examiners to do a more efficient job in detecting specific problems that are developing in the associations that will permit us to focus our examination resources on the critical areas of operation without spending it on less important matters, and, therefore, it is our judgment that we think we can provide adequate examination. But we are going to have to wait and see and we will be back, if necessary.

BUDGET REPROGRAMMING PROVISION

Senator GARN. During fiscal year 1984, we provided the Bank Board with the flexibility of transferring up to 10 percent of its resources from one account to the other, with the approval of the committees.

Do you anticipate a need to exercise this provision during the remainder of this year, fiscal year 1984?

Mr. GRAY. Let me ask the Director of the Office of Examinations.

Mr. SCHILLING. I think Mr. Pittman may have that information.

Mr. PITTMAN. No, Mr. Chairman, we do not expect that we will exercise this provision for the remainder of this year.

Senator GARN. Would you recommend that we retain this provision for fiscal year 1985?

Mr. PITTMAN. Yes, sir; we strongly request that it be retained. We have an organizational study underway right now and it is a very real possibility that the outcome of that study may point to realignment of some of our agency people resources.

CONDITION OF THE THRIFT INDUSTRY

Senator GARN. You indicated in your statement that while the industry as a whole turned a profit of over $2 billion in 1983, over one-third of all insured organizations lost money.

Do you feel that the underlying problems of the institutions is still the general state of the economy, high cost of money to them, and still trying to ferret out a lot of the older long-term loans?

Mr. GRAY. Absolutely do. Thirty-five percent of all efforts that I see in preferred institutions lost money in 1983. The underlying problems of these institutions and of the industry in general is that despite substantial restructuring they are still holding large volumes of low-rate mortgages that yield less than the cost to obtain deposits. As you suggest, this will be a continuing problem until these old loans are repaid.

Senator GARN. I think there is a general impression that the thrift industry is in good shape and I suppose, relatively speaking, compared to 1982 it is, but I would like to emphasize that point very strongly, that it is a relative improvement. And as long as the economy is in the condition that it is in, we are in again relatively good shape, and I emphasize the relatively. But if we have continued increasing interest rates and another downturn in the economy, I don't think anybody should be surprised that the thrift industry will be in very dramatic trouble again. Would you agree with that?

Mr. GRAY. I would agree, unfortunately, wholeheartedly that that is precisely the case. Every basis point that rates go up, the industry is directly affected, and not only the state of the industry, but certainly, indirectly, the safety and soundness of the emphasis that I see.

Senator GARN. Does the distribution of the thrift institutions still in the red reflect geographic differences or any geographic patterns?

Mr. GRAY. The percentage of institutions in the red vary considerably among Federal Home Loan Bank districts, ranging from only 19 percent in San Francisco to 54 percent in the Des Moines district. Losses were less frequent in areas with rapid growth where a smaller proportion of loans were sold and where there are more new institutions. The percentage of FSLIC-insured institutions that lost money in 1983 by Federal Home Loan Bank districts is available and I would be delighted to provide them for the record.

Senator GARN. Thank you.

[The information follows:]

Percentage of total FSLIC-insured institutions, by district, with negative net income in 1983

FHL bank district	*Percent*
District 1—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont	20.79
District 2—New York, New Jersey, and Puerto Rico	30.25
District 3—Delaware, Pennsylvania, and West Virginia	24.15
District 4—Alabama, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, and Virginia	36.42
District 5—Kentucky, Ohio, and Tennessee	45.41
District 6—Indiana and Michigan	43.86
District 7—Illinois and Wisconsin	37.22
District 8—Iowa, Minnesota, Missouri, North Dakota, and South Dakota	53.50
District 9—Arkansas, Louisiana, Mississippi, New Mexico, and Texas	26.38
District 10—Colorado, Kansas, Nebraska, and Oklahoma	33.33
District 11—Arizona, California, and Nevada	18.88
District 12—Alaska, Hawaii, Guam, Idaho, Montana, Oregon, Utah, Washington, and Wyoming	26.98

MORTGAGE VERSUS NONMORTGAGE ASSETS

Senator GARN. You note that all types of nonmortgage loan investments affected by the new legislation comprise 0.7 percent of total assets in June 1982. December 1983 the figure only increased to 1.7 percent. This has been an issue of considerable concern, possibly without justification. What percent of FSLIC-insured assets are now in qualified home loans and related assets as compared to the previous year?

Mr. GRAY. At the end of 1983 approximately 79 percent of the assets of FSLIC in insured institutions were the type considered to be qualified under the Internal Revenue Code provision 593. This was only slightly less than the 81 percent of the year earlier.

Senator GARN. Do you have any estimate of what this percentage might be in the next year?

Mr. GRAY. Well, given our experience, the strong demands for mortgages and the industry commitment in housing, in fact, have continued to be emphasized in a number of hearings. A reasonable estimate for next year would be about the same 2 percentage point high.

FSLIC INSURANCE RESERVES

Senator GARN. Since December 31, 1980, almost all income received by the FSLIC has been expended to solve problem cases while total deposits have increased by 25 percent. In your statement you note that: "The fund is already under enormous stress" and "strong remedial action" may be necessary.

What remedial actions would you recommend?

Mr. GRAY. Well, for those institutions that engage in activities beyond the asset limitations established, the appropriate premiums should be contributed to the FSLIC which underwrites such activities. The Bank Board recognizes that such a proposal would require statutory change and we have proposed this, the Board and the Senate Banking Committee, a few weeks ago. The size of the FSLIC Federal insurance fund, which as I mentioned is $6.3 billion, now represents a ratio of FSLIC approaching a historic low point. As I indicated, it has deteriorated from a level of 2 percent in 1970 to around 1 percent today.

Senator GARN. What in your mind is an appropriate level of reserves to maintain?

Mr. GRAY. Well, it is difficult to establish a ratio of reserves deposits as an appropriate level. In periods of economic stability, almost any level would be adequate; however, during periods of severe economic conditions, it is possible that the level of reserves necessary to fund the FSLIC obligations is such that to obtain that level would be too costly to achieve.

So we believe that an appropriate level of reserves can be maintained through the current additional assessment authority if that should be necessary.

This option would be less burdensome on insured institutions than would otherwise be necessary to attempt to go to the insurance reserves by other means. And what other means? Those means would be to increase the insurance premium by one-eighth of 1 percent above and beyond what it is now, and we have the authority to do that. However, were we to do that, in a year's period of time it would cost the industry $781 million.

I have mentioned that the operating income of the industry, irrespective of what it is reported, is extremely low; its reports vastly overstate operating income. So if you were to impose that kind of premium on the industry, it would be thoroughly counterproductive. You can't squeeze anything out of a turnip if it is not there. We are between a rock and a hard place on this issue, but the additional assessment authority that I talked about is the most appropriate option in my mind.

NEW BOARD MEMBER

Senator GARN. Mrs. Grigsby, after 2 weeks on the job are you still happy the Senate Banking Committee approved your nomination?

Mrs. GRIGSBY. Well, let me think about that one. No, I haven't. It has been very interesting. I think the thing that I have enjoyed the most is all the controversial things that come up; they are enjoyable. I like to try to solve the problems.

Senator GARN. You should be very happy then in your position. [Laughter.]

Mrs. GRIGSBY. I like to solve problems.

Senator GARN. You are going to enjoy every day.

SUPERVISORY ACTIONS

Mr. GRAY. I would like to ask that you insert into the record a memorandum which has been sent today by the three members of the Federal Home Loan Bank Board to all supervisory agents, Office of Examination and Supervision, assistant directors, and district directors. This regards a number of supervisory actions that we are directing the

Federal Home Loan Bank supervisory staffs and the Office of Examination and Supervision staffs to immediately undertake. It was sent today and I think it is timely. I would appreciate you inserting that in the record.

Senator GARN. We will be happy to include it in the record.

[The memorandum follows:]

MEMORANDUM FROM EDWIN J. GRAY, CHAIRMAN, FEDERAL HOME LOAN BANK BOARD

APRIL 12, 1984.

To: All supervisory agents, OES assistant directors, and district directors.

Subject: Supervisory actions.

The administration of proper, timely and forceful supervisory actions in problem cases is of utmost importance to this Board. In that light, we want to reaffirm and stress some of our standard operating procedures regarding supervisory actions and to require some additional procedures aimed at ensuring that full supervisory responsibilities are met. In light of problems that have occurred, implementation of these procedures is of utmost urgency and should begin immediately.

1. When examination reports—final or interim—reveal substantial problems of any type, the Supervisory Agent will immediately meet with the institution's board of directors and: (1) discuss the problems; (2) require expeditious corrective action and; (3) obtain a formal supervisory agreement in order to obtain such corrective action.

2. The Supervisory Agents are directed to review all exam reports completed within the last 12 months for comments which disclose disarray in the institution's books and records to such an extent that they do not provide an accurate and complete record of all business transactions. Such failure to maintain records is a violation of the insurance regulations and is an unsafe and unsound practice. If an institution has not promptly taken appropriate corrective action after the Supervisory Agent has requested corrective action as described in (1) above, the Supervisory Agent is to immediately refer the case to the Enforcement Division of OGC, through the OES Assistant Director, for the initiation of a cease and desist proceeding. Similarly, if future examination reports disclose failures to maintain adequate books and records, as described above, the Supervisory Agents are directed to follow the same procedures.

3. The OES District Directors are directed to obtain immediate on-site evaluation of institutions that exhibit excessive growth or significant behavioral deviations from past performance.

4. The Supervisory Agents are directed to require submission of business plans by the proposed applicants in connection with all change of control filings. The District Directors of OES are directed to examine institutions within six months after the change in control and to determine that the institution is operating pursuant to the business plan.

5. The OES Assistant Directors—Regional Operations are responsible for monitoring the results of examinations and the resulting supervisory actions to ensure that uniform, effective and appropriate supervisory actions are taken. If the supervisory actions are not appropriate, the Assistant Directors will take immediate, forceful corrective action.

EDWIN J. GRAY,
Chairman.

DONALD I. HOVDE,
Board Member.

MARY A. GRIGSBY,
Board Member.

SUBMITTED QUESTIONS

Senator GARN. I have no additional oral questions. I do have 24 pages of questions for your response in writing. I appreciate very much your willingness to be here today.

Mr. GRAY. Thank you very much, Mr. Chairman.

[The following questions were not asked at the hearing but were submitted to the Board for response for the record:]

QUESTIONS SUBMITTED BY SENATOR GARN

RECEPTION AND REPRESENTATION EXPENSES

Question: Page C-14 of your budget justification shows your level of expenses in both 1984 and 1985. I realize you submitted bill language to double the present $1,500 limit on Reception and Representation expenses to $3,000 in 1985. Do you understand that the 1984 statutory limitation of $1,500 remains in effect until there is a language change?

Answer: Yes, we understand that the 1984 statutory limitation of $1,500 remains in effect until there is a language change.

Question: Only three agencies in our bill have $3,000 representation funds: HUD, EPA and the Veterans' Administration. The Consumer Product Safety Commission, which is similar to the Bank Board -- both in size and structure, gets only $500. How do you justify an increase to $3,000?

Answer: The Board has become involved in a wide range of activities with increased occasions for hosting Congressional members, agency heads, industry, and consumer group leaders. The present limit is no longer adequate to meet the Board's needs in the conduct of its official business.

We understand that the Comptroller of Currency and the "Fed" budget are substantially more than the increase we are requesting.

PROFIT OF S&L'S

Question: Preliminary data indicate that FSLIC-insured institutions had net after-tax income of about $2 billion in 1983, in sharp contrast to the $1.1 billion loss a year earlier and the record $1.7 billion loss in 1981. Last year's profits represented a return on assets of about 0.27 percent. As you note, however, most of last year's profits represent "unusual non-operating income". What would you estimate profits would be if the income associated with special accounting procedures was eliminated?

Answer: Net income of FSLIC-insured institutions before income taxes was $2.6 billion in 1983 (income taxes reduced after-tax profit to $2.0 billion). Net non-operating income (primarily profit on the sale of assets) amounted to $2.5 billion or about 95 percent of all before-tax profit. The bulk of this appears to reflect sale of assets written down as a result of mergers made when interest rates were high, although we have no precise figures. At any rate, prior to 1982, net non-operating income never exceeded $1.0 billion and was generally closer to $0.1 billion. If we were to eliminate special accounting income, thrift income last year was certainly well under $1.0 billion.

BROKERED FUNDS

Question: One of the major factors you associate with asset quality is "Brokered Funds". Recently you closed down an S&L near Dallas with a payout of over $296 million required, and I understand an even larger institution in San Marino, California, is in serious trouble. I know that recently the Bank Board and FDIC took final regulatory action which would virtually stop brokered funds by October 1. Would you please explain, for the benefit of the Subcommittee, the regulatory action you are taking and it expected effect on brokered funds?

Answer: With the Federal Deposit Insurance Corporation (FDIC), the Board on March 26 unanimously voted to amend the agency's regulations to limit to $100,000 the insurance coverage afforded to deposits placed by or through a broker with an insured bank or savings association. The Board also adopted a related interim final regulation which prohibits institutions having a net worth of 3 percent or less from accepting brokered deposits in excess of 5 percent of their total assets. The interim final rule is intended to prevent troubled institutions from loading up on brokered deposits during the phase-in period from March 26 to October 1, 1984.

Question: Are brokered funds a problem in all institutions?

Answer: No. Less than one-fifth of all FSLIC-insured institutions are in any way involved with brokered funds.

Question: What comprehensive studies have you conducted on the effect of brokered funds on problem S&L's and on the industry at large?

Answer: We have conducted studies and can make them available to you as you require.

Question: Are all brokered funds a problem -- or is it just a few "bad apples"?

Answer: Brokered funds are not inherently evil. The problem is the use in which the funds may be put as a result of instantaneous access and hurry up investments. Some institutions have made good use of brokered funds. The problem is that you don't need too many cases of misused funds to cause a very serious impact on the FSLIC Fund. That has been our principal concern.

Question: If the problem is, in fact, so critical, why are you delaying the effective date for more than six months to October 1, 1984?

Answer: We have allowed the phase-out period as time for the industry and the brokering institutions to get ready for the change and to avoid disruption in the financial markets.

Question: Many members of Congress -- including almost half of the House Banking committee -- have urged you and the FDIC to postpone a decision until additional study is made of this problem. What is your response to them?

Answer: The Board believes that there was sufficient information available to proceed with the issuance of the final rule. The Board undertook an extensive rulemaking proceeding beginning with the issuance of an Advance Notice of Proposed Rulemaking in November, 1983 and followed by the issuance of a proposed rule in January, 1984. The Board alone received over 3400 comment letters on the proposed rule. Given the problems presented by the proliferation of insured brokered deposits and given the extensive rulemaking proceeding, the Board believed that it had more than sufficient information.

Further delay would only serve to permit the continuing mushrooming of FSLIC-insured brokered deposits and to increase the exposure of the FSLIC insurance fund. A delay would permit the continued trend of problem cases involving large amounts of insured brokered deposits coming before the FSLIC for resolution.

Question: Are you planning to conduct a comprehensive, in-depth analysis between now and October to better identify the problem and the implications of your regulatory action?

Answer: Yes. We plan to finish by October an in-depth analysis of the problem and the implications of our regulatory action.

ADJUSTABLE RATE MORTGAGES

Question: The increase in Adjustable Rate Mortgages (ARM) was striking — almost two-thirds of the home mortgages made in December had variable rates. Does this represent a situation where ARMs are the consumer's financing choice or are Adjustable Rate Mortgages just the only money available in many areas?

Answer: Available evidence suggests that the sharp rise in the variable rate mortgage share of total home mortgage lending last year reflected extensive consumer education and the substantially lower rates that began to be charged for variable, rather than for fixed rate mortgages. Most consumers clearly had a choice between a fixed and a variable rate loan, frequently from the same institution. Our monthly survey of mortgage lending policy, for example, showed that last December 80 percent of all savings and loan associations were offering fixed rate mortgages, 46 percent capped variable rate mortgages, and 64 percent uncapped variable rate mortgages.

FINANCIAL MODELS

Question: In your statement, you make reference to the fact that you are studying the feasibility of developing computer-based simulation models to be used in evaluating different investment and funding strategies. You expect to make these models available to member institutions on a fee basis. To what extent are such models already commercially available?

Answer: There currently is a broad array of financial simulation models commercially available. We have not, however, done an evaluation of such models.

Question: Please provide, for the record, a list of those commercially available models that would provide information similar to the output your model would provide and indicate the major differences, if any.

Senator Garn—Continued

Answer: A partial listing of firms that currently provide asset/liability management models for thrift institutions is as follows:

Data Resources, Inc.
GFC (subsidiary of Gibraltar Savings)
Prudential - Bache
R. F. Smith & Associates
Columbia Associates
Bank of New England
Investment Support System
Mark Powers
Saddlebrook

We do not have information on specific features of the various models offered by these firms. We expect that they will vary in purpose and scope of analysis.

Question: How will you assure that the institutions understand the assumptions underlying the model and know the risk associated with violating these assumptions?

Answer: Through training as discussed in the answer to the next question.

Question: What training do you expect to undertake in order to support member institutions use of your model?

Answer: Each Bank will hold, and each user will be required to attend, an intensive seminar on design and use of the models. At these seminars, users will be fully informed of the assumptions underlying the models and how the models should be used in the manager's decision-making process.

Question: What resources will be necessary to support this model development program in FY 85?

Answer: No FHLBB budgetary resources will be used to support the program. All staff and funds used to support the program will be provided by the FHLBanks. The program will be priced so as to cover the Banks' costs for providing this service to members.

SHORT AND LONG TERM INTEREST RATES

Question: As you pointed out, the most obvious benefit to the S&L industry was the sharp drop in short-term interest rates — the cost to S&L's of borrowing money. Is it true that the current difference between short and long term rates is far greater than the historical average?

Answer: The spread between long and short term interest rates is currently large and clearly greater than the historical average. The spread between long and short term interest rates, however, changes cyclically, and there were earlier periods, such as the mid-1970s, when the spread was even wider than now. We think the spread between short and long term interest rates will continue to vary significantly in the future.

Question: Do you see this present situation as temporary or are there reasons to expect that the spread between short and long term interest rates will continue to remain greater than it was in the past?

Answer: We have no reliable basis for projecting what the average will be in the future, but suspect, at least in absolute terms, that the spread will be somewhat wider than in the past because the overall level of interest rates will be higher.

Question: You spoke of the need for portfolio restructuring to reduce interest rate-risk exposure. How long do you think S&L's will have to restructure — one year, three years, longer?

Answer: Mortgage loans, on average, stay on the books for 7 years, with low-rate loans staying even longer. Total restructuring, therefore, is likely to take the better part of a decade. A fairly substantial portion could be realized in 3 to 5 years.

Question: Many S&L's have portfolios primarily made up of long term, fixed rate residential mortgages. Realistically, how much can they restructure in a couple of years?

Answer: Since low-rate loans tend to be repaid relatively slowly, it will take time to eliminate the drag of these loans on thrift industry earnings. The situation will be substantially eased, however, when more current rate mortgages are acquired. The industry made substantial progress last year in this area.

Question: How much progress has been made at restructuring in the past year?

Answer: During 1983 institutions improved their asset-liability match by increasing their proportion of adjustable interest rate mortgages. The share of such loans in total conventional home mortgage lending rose from a low of 26 percent in May to 63 percent in December. At yearend 1983, about 12 percent of all mortgages held by FSLIC-insured institutions were variable rate loans, up from 9 percent a year earlier. Obviously, however, complete restructuring will require a considerable period of time.

FIELD EXAMINATION PERSONNEL

Question: For FY 84, you requested — and this Subcommittee provided-- 929 FTEE for field examinations and supervision. The President's budget now indicates that only 875 FTEE will be used in 1984, 54 less than what was approved. And at the same time, you are now making a special request for more people to meet a critical shortage. Why are there all these changes in direction?

Answer: We do not consider that there have been changes in direction on the part of the FHLBB. We have consistently tried to accomplish our mission with the least necessary use of resources, human and monetary. However, we are now seeing the emergence of credit-risk problems generated, in part, by efforts to solve the interest-rate risk problems of recent years.

The explosive expansion in brokered funds to try to "grow out" of such problems has added fuel to the fires. This phenomenon of too-rapid growth based upon brokered funds is a comparatively new development.

Question: Did OMB reduce 1984 resources in the deliberations over your 1985 request?

Answer: Yes. Our resources for 1984 were reduced.

Question: Did you appeal?

Answer: No. Not at the time of our budget passback, but recently when the magnitude of asset quality problems became fully evident.

Question: The President's budget was submitted to Congress about 60 days ago. How is it that you only recently became aware of this shortage?

Answer: Mounting, alarming evidence of the extent of asset-quality problems.

Question: When do you expect a budget amendment to be formally submitted?

Answer: OMB indicates the amendment will be formally submitted to the Congress within the next 3 weeks.

Question: Will the increase be only for 1985, or will additions also be sought for 1984?

Answer: The budget amendment will address the increase only for the FY 85 budget cycle. For the remainder of FY 84, we feel we have sufficient FTE savings from the first half of the fiscal year to enable us to staff-up to the desired higher levels without the need for additional employment ceiling.

FUNDING FOR THE NEIGHBORHOOD REINVESTMENT CORPORATION

Question: Are there funds or services provided in your FY 85 budget for the Neighborhood Reinvestment Corporation during FY 85?

Answer: The Federal Home Loan Bank System would be pleased to continue providing contributions in FY 85. These funds are not contained in the budget before you, however, because they derive from Federal Home Loan Bank System funds.

ASSET QUALITY

Question: In addition to interest rate risk, I gather from your statement that the problem of "Asset Quality" is the other major threat now facing the industry. Your statement mentioned that the new quarterly financial reporting system will force S&L's to explicitly examine their interest rate risk exposure. What requirements do you place on S&L's to consciously examine the quality of their assets?

Answer: Requirements to adopt prudent underwriting, appraisal, and credit policies are in place.

Question: Do the field examiners and the Bank Board now have routine procedures in place to identify asset quality problems before institutions get into serious financial trouble?

Answer: Yes. The examiners have written materials - a book of examination objectives and procedures and specific examination programs - for this purpose.

Question: Why are on-site examinations required to check asset quality?

Answer: There is no other process yet available to determine if the adopted policies are indeed prudent and are being adequately adhered to. It is necessary to inspect and evaluate the documentation underlying the reported investments.

Question: With all the advances in automated financial analyses, can't you devise some way to do automated monitoring?

Answer: The new monitoring process, based upon the new quarterly reports, has been designed to "flag" probable increases in "asset quality" problems as well as interest-rate risk problems. When the monitoring indicates a problem, the examiners will go to the institution to make a specialized examination in that area.

Question: Isn't there a way to automatically flag construction loans or other kinds of assets that are not fully collateralized?

Answer: This could be done to some degree but at a rather high cost. In addition to imposing substantial new reporting requirements, we would still be faced with the problem of verifying such data.

OFFICE OF EXAMINATIONS AND SUPERVISION

Question: Page C-60 shows that workload requirements in the Office of Examinations and Supervision increase across the board in 1984 and 1985. However, you are showing a net reduction of 18 FTEE or about 25% in this office. How can this office meet its growing responsibilities with so many fewer people?

Answer: This Board believes that many of the functions of the Office can better be handled in the field at the Federal Home Loan Banks and the District examination offices. We are currently reviewing our operations and the existing delegations of authority to determine where further delegations will improve both the timeliness and quality of our efforts.

We wish to retain at the Washington level the capacity to properly monitor the results of operations with intercession only in instances of non-adherence to FHLBB policies or those cases where we believe the actions proposed or taken are materially in error. There are other functions to be retained where it is imperative that there be centralized control to assure even-handedness of application.

We are also making efforts to streamline and expedite those processes of application reviews and monitoring of results which must be retained at the Washington level.

We believe the process of centralized policy-making and decentralized execution to be the preferred mode of management.

Those persons now performing work that can better be done at the local level can be redirected for improved performance of the functions retained.

This move is still in its early stages. It is possible that properly controlled delegation cannot be completed as quickly as contemplated. If that proves to be the case, our 10 percent staffing leeway authority will suffice to assure the full execution of the national responsibilities.

CHANGES IN FY 84 OPERATING PLAN

Question: Throughout your budget justification, the differences between the 1985 request and the 1984 current estimate are quite small. The major differences are between your 1984 budget estimate and your current operating plan for FY 84. What are the underlying reasons for the substantial changes in the 1984 program you defended before this Subcommittee last year?

Answer:Reduction in Headquarters staffing created savings, but there were necessary increases in other expense areas such as travel, telephones, and contractual printing.

Question: Page B-6 shows a total of 1,391 FTEE in 1984 -- this is 53 FTEE less than requested and provided last year. If you use 53 fewer FTEE than projected, this will save at least $2,000,000 in personnel compensation and benefits. But your estimated total expenses are not decreased at all. Why not?

Answer: There were necessary increases in those previously mentioned "other expense" areas. Also, we had to absorb this year's comparability pay raise within this total without the aid of a pay supplemental as in previous years.

PERSONNEL COMPENSATION AND BENEFITS

Question: The table on Page C-4 of your budget justification shows a shift of $472,000 from personnel compensation and benefits (PC&B) to contractual services. This shift involves a decrease from your FY 84 budget justification as a result of your FY 84 operating plan. Why was this shift of funds necessary?

Answer: To meet increased expenses in travel, communications costs, contractual printing, and depreciation expense on capitalized equipment purchases.

Question: Did you notify the Committee of this change?

Answer: It was our hope and intent that the complete and detailed disclosure of this need, which was documented in our budget justification, would satisfy this purpose. It is true that separate correspondence was not submitted on this need.

Question: Section 409 of the HUD Appropriations Act that requires approval of alternate uses of PC&B funds for all agencies using appropriated funds. Why shouldn't the Bank Board be subject to these same limitations?

Answer: The Bank Board is subject to this provision and we will certainly provide whatever additional justification you may require.

COMPUTER CONTINGENCY ACCOUNT

Question: Last year you requested $50,000 for a computer contingency allowance. These funds were to be used if your in-house computer has extensive down time and you are required to purchase time elsewhere. How much has been used for this purpose to date in FY 84?

Answer: None. So far, the computer contingency allowance has not been needed.

Question: How much did you budget for this "computer contingency" in FY 85?

Answer: We have eliminated any amount for a contingency allowance in this line item. This is due to the confidence we have acquired through experience with the high percentage up-time of our computers. We have not had to use the contingency in the past several years. The $148,000 shown for this line item is planned totally for the increased amount of time sharing required to support our statistical analysis and economic modeling.

ADVANCES TO MEMBERS

Question: How much was advanced to member institutions during FY 83?

Answer: Member institutions were advanced $57,861,971 during FY 1983.

Senator Garn—Continued

Question: What are your projections for FY 84 and FY 85?

Answer: Our projections for FY 84 and FY 85 are $61,400,000 and $67,400,000, respectively.

TRAINING

Question: Your FY 84 budget estimate included $220,000 for training. How much do you now expect to spend on training during FY 84?

Answer: We expect to spend $250,000 on training during FY 1984.

Question: What are your estimates of the number of employees that will receive training during FY 84?

Answer: Approximately 380 employees will receive training in FY 1984.

Question: What is the dollar level and numbers of trainees for FY 85?

Answer: We are requesting $240,000 for FY 85 to train approximately 360 employees.

BUILDING OPERATING EXPENSE

Question: Please submit a list of tenants occupying space in your building. Include the FY 83, 84 and estimated 85 revenue from each tenant in terms of annual revenue and per square foot revenue.

Answer: The requested information is shown on the following page.

TENANT	LEASED SQUARE FOOTAGE	RENTALS FY 83 TOTAL	RENTALS FY 83 PER SQ FT	RENTALS FY 84 (PROJECTED) TOTAL	RENTALS FY 84 (PROJECTED) PER SQ FT	RENTALS FY 85 (PROJECTED) TOTAL	RENTALS FY 85 (PROJECTED) PER SQ FT
Liberty Gifts	479	$ 13,308	$27.78	$13,695	$28.59	$ 14,380	$30.00
Standard Drug (MEDCO)	1,943	38,837	20.00	41,340	21.28	42,060	21.65
Central Travel	732	16,959	23.17	19,308	26.38	19,560	26.72
Massey Shoes	1,681	33,055	19.66	34,344	20.43	35,683	21.23
1725 F. St.	13,817	280,520	20.30	286,401	20.73	302,826	21.92
Frankie Welch	1,547	26,350	17.03	30,120	19.47	30,120	19.47
Liberty Plaza Optical	1,228	23,067	18.78	24,106	19.63	24,104	19.63
Impression	1,422	20,714	14.57	24,264	17.06	24,264	17.06
K&K (Klein's)	916	15,916	17.37	16,614	18.14	17,279	18.86
Crown Books	3,500	54,000	15.43	59,247	16.93	60,996	17.43
Totals (Rent Only)	27,265	$509,418		$549,439		$571,272	
Averages (Rent per square ft)			$19.40		$20.15		$20.95

Senator Garn—Continued

MINORITY-MANAGED-AND-OWNED INSTITUTIONS

Question: How many insured associations currently qualify as minority-managed-and-owned?

Answer: There are currently 74 savings and loan associations that qualify as minority associations. The association distribution is as follows:

Ethnic Group	No.	Assets
Black	36	$1,208,854,987
Hispanic	25	1,337,116,344
Asian American	12	1,380,570,380
Women	1	20,859,140

Question: Were these institutions more severely affected by the recent economic difficulties in the financial community?

Answer: Minority associations, like the rest of the thrift industry, have suffered through the many recent changes and interest rate fluctuations. The number of minority associations has dropped from a high of 84 in 1979 to the current level of 74. During this period, 22 associations were merged, were acquired by other associations, or lost control to non-minority ownership. Also during this period, 12 new minority associations were established.

Question: What do you see as the future for these institutions and what steps is the Board taking to assist such minority institutions?

Answer: There is no complete answer to this question. Some of the minority-managed-and-owned institutions did poorly during the economic downturn. However, these institutions were by and large marginal operations to start with. Others fared better than the average because they had a large proportion of low-cost passbook money. Much of this low-cost money stayed with the institutions rather than being rolled over into higher-cost savings instruments.

Current Bank Board efforts to assist minority associations include:

- Offering technical assistance and training through the Minority Assistance Development Division, Office of Community Investment.

- Revising our regulations and procedures to assure that minority associations receive all the preferential treatment prescribed in the Garn-St Germain legislation.

VOLUME OF MORTGAGE LOANS

Question: The total dollar volume of mortgage loans made by member savings and loan associations in FY 82 dropped to $45.5 billion. At last year's hearing, you estimated that loans closed were expected to rise by 80% in FY 83 and an additional 57% in FY 84. How do these projections compare to the actual loan closures in FY 83 and in FY 84 to date?

Answer: We sharply underestimated the rise in mortgage lending by FSLIC-insured institutions in FY 83, primarily because we had not anticipated the extraordinary inflow of deposits resulting from the introduction of money market deposit accounts or MMDAs, and the utilization of brokered deposits. Mortgage lending totaled $118.4 billion in FY 83. This was a 160 percent increase from FY 82, twice what we had estimated. Thus far in FY 84 (5 months), mortgage loans closed have totaled $60 billion. This is 90 percent more than a year earlier, also substantially more than estimated earlier. We expect, however, the year-to-year gains will begin to slow soon as comparison is made with the large lending volume that was attained by last spring and summer.

RENT, COMMUNICATIONS AND UTILITIES

Question: In FY 83, you obligated $1,609,048 for rent, communications and utilities. In FY 84, you are estimating a requirement for $1,821,000. For FY 85, you are requesting $1,674,000 or a decrease of 8% from the FY 84 level. You project a large decrease (33%) in funds needed to rent equipment. How do you explain that decrease?

Answer: The reduction is due to a decision to purchase a standardized word processing system rather than continuing to rent numerous makes and models as in past years. The purchase of word processors will be completed during FY 1984 so that there should be no need for rental costs in FY 1985.

INSURANCE CLAIMS

Question: Could you please bring us up-to-date since last year in terms of additional insurance claims, additional provisions for losses and actual losses?

Answer: As of December 31, 1983, FSLIC had established loss reserves of $1.008 billion; $108 million was for insurance settlement activities of which there were 6 such actions in 1983. Since calendar yearend, FSLIC has been involved in 3 additional insurance settlement activities. We estimate that FSLIC will incur losses on these three cases of approximately $175 million.

TRAVEL AND TRANSPORTATION OF PERSONS

Question: On Page C-11 of your budget justification, you present a table containing your travel and transportation of persons expenses for FY 83 through FY 85. Your Office of the Chairman shows an increase in travel from your FY 84 request to your current estimate for FY 84 of $8,000. Your Communications Office shows an increase of $10,000 from your original FY 84 request to your current estimate for FY 84. Additionally, your Office of District Banks show an increase of $14,000 and your Office of General Counsel is increased by $52,000. Could you please explain the need for each of these increases in FY 84?

Answer: Most of this increase is attributable to the continuing problem case activity where it is frequently necessary for members of our professional staff from the Washington offices to lend their expertise and assistance in a given case. Legal support is a good example.

Senator Garn—Continued

Question: Overall you are expecting to spend $160,000 more on travel than contained in your FY 84 budget request. This represents a 31% increase. You obviously underestimated your travel need by a significant amount -- why is that?

Answer: We did initially underestimate our travel needs with the expectation that the volume of problem cases would subside. Unfortunately, these industry problems have persisted and added problems such as asset-quality have surfaced.

COMPENSATION FOR MEMBERS

Question: Section 354 of the Garn-St Germain Depository Institutions Act of 1982 authorized compensation for members and alternates of the Federal Savings and Loan Advisory Council. In FY 84, you requested $60,000 to provide such compensation. I understand that the majority of these funds have been reallocated. Could you explain what your plans are for FY 84 and FY 85 relative to compensation and travel of members and alternates?

Answer: An Executive Branch Directive was promulgated last year effective the beginning of FY 1984 stating that, henceforth, Federal Advisory Council members should no longer be compensated unless the cognizant agency head could demonstrate that it was not possible to obtain such advisory members on a purely voluntary, non-compensated basis. Accordingly, we terminated compensating the council members this fiscal year.

The Directive does not prohibit reimbursing the members for their travel costs and we continue to do so.

STATE TRAINING PROGRAM

Question: Please describe your training activities in FY 84 and FY 85 and what you consider to be your most significant accomplishments during the past year.

Answer: During FY 1984 we will provide training for 700 state examiners through participation in OES's training programs. This number should remain constant for next year since we have maximized the effective usage of the funds budgeted for state training. We have achieved a fully integrated training program with both state and federal examiners participating at all training sessions. These endeavors have been so successful that state examiners now share instructor responsibilities with our own examiners for all the training courses we conduct. This training ranges from basic examination procedures to highly complex analytical courses. The majority of this training has been developed and implemented in the past two years to prepare state and federal staff for changes in the S&L industry brought about by such legislation as the Garn-St Germain Depository Institutions Act of 1982. Courses currently offered are:

New Examiner Training School
Real Estate Appraisal School
Intermediate Examiner Training School
Electronic Data Processing School
Senior Finance School
Business Lending School

Financial Instruments, Futures & Options
Basic Entry Level Trust School
Instructor Training
Management Workshop
Electronic Data Processing Work Program
Electronic Data Processing Technology Seminar

RESTRUCTURING ACTIVITIES

Question: Please describe the benefits of the Freddie Mac's collateralized mortgage obligations and the Boards role in their implementation.

Answer: The benefit of collateralized mortgage obligations (CMOs), which were initiated by Freddie Mac, is that they allow for far greater certainty on the part of investors as to the maturities of the instruments they hold. A primary problem with mortgage loans is that they can be repaid anytime within a 25-or-30 year period. CMOs, by creating a number of different kinds of securities backed by the same mortgage pool, allow for investors to purchase mortgage-backed securities with far more certain maturities than those of the underlying mortgages. Since the members of the Federal Home Loan Bank Board are also the members of Freddie Mac's board, we are accountable for the advent of the Freddie Mac CMO.

Question: Please describe the Board's activities in the area of interest rate swaps.

Answer: The Board adopted Interest Rate Swap Guidelines for the FHLBanks on February 3, 1984. Since then, the boards of directors at eight FHLBanks have adopted programs for their Banks' participation in swap transactions. (As of April 10, 1984, FHLBanks with policies in place included Boston, Atlanta, Cincinnati, Indianapolis, Chicago, Dallas, Topeka and Seattle.) As of April 10, 1984, the Dallas and Seattle Banks have engaged in swaps with underlying notional principal of approximately $500 million. (The notional principal is the amount underlying a swap transaction and upon which the calculation of interest payments is based.)

The remaining Banks are expected to begin their swap programs before mid-year.

QUESTIONS SUBMITTED BY SENATOR HUDDLESTON

INTEREST RATES

Question: Of what magnitude do interest rate savings have to reach to pose a threat to the S&L industry? Suppose rates stay where they are or rise perhaps one-half to one percentage point — is that a problem?

Answer: Even though the S&L industry in the aggregate was profitable last year, 35 percent of all such institutions were in the red. Consequently, an interest rate rise as small as 100 basis points would eliminate all industry profits, and a larger rise would produce an operating loss for the industry as a whole.

Interest rate increases affect S&L profitability in a number of ways. First, demand for credit (mortgages) decreases as the price of credit (interest rates) increases. This reduces income from fees for originating of mortgages. Since fee income is currently a substantial portion of industry income, any decrease in the volume of mortgage lending would adversely affect the financial health of the industry.

Secondly, as interest rates rise there is a decrease in the difference between short-term and long-term rates. Usually in periods of rising interest rates, short-term rates increase faster than long-term rates. This relationship between short-term and long-term rates — i.e., the slope of the yield curve — is important to the S&L industry, since S&Ls tend to borrow money in the short-term market (passbook accounts, and short-term CD's) and invest in the long-term market (20-30 year mortgages). Thus, the larger (smaller) the difference between short-term rates and long-term rates, the greater (smaller) the profit margin on mortgage lending.

In the last three months, interest rates have increased by 75 to 100 basis points. Concurrent with this increase has been a narrowing of the difference between long-term and short-term rates. At the end of 1983, the difference between short and long term rates was about 250 basis points, as opposed to the current difference of 190-200 basis points. This recent increase in interest rates and flattening of the yield curve will significantly reduce the profitability of the industry. If current rates remain unchanged, however, the industry should continue to generate small but positive profits. However, a further increase of 100 basis points in interest rates (1 percentage point) and a concurrent decrease in the difference between long and short term rates to 100 basis points would eliminate all profits in the industry.

Question: Would higher rates alone throughout the rest of this year pose a threat or just swings in interest rates?

Answer: S&L earnings under current interest rates are extremely fragile and any increase in interest rates would threaten the viability of the industry. Swift upward changes in interest rates ("swings") present a more severe threat to the industry now than they did in the 1980-1982 period, because it has less net worth with which to absorb temporary operating losses. Although S&Ls have begun to reduce the interest rate risk in their portfolios by issuing adjustable rate mortgages (ARMs), the industry has not had sufficient time to issue enough ARMs to materially effect their portfolios. A sudden large upward shift in interest rates would have a devastating effect on the industry.

INDIVIDUAL RETIREMENT ACCOUNTS

Question: Is there any indication of the amount of IRA money going into S&Ls? Are they getting a reasonable share?

Answer: For some years, the Bank Board has obtained information on the dollar amounts in both IRA and Keogh Plan Accounts at FSLIC-insured institutions each March and September. This information is shown in the following table:

Individual Retirement Account (IRA) and
Keogh Retirement Plan Account Balances
at FSLIC-Insured Institutions

	Balances Outstanding ($millions) IRA	Keogh	Total	Total as a Percent of Total Deposits
1976 - March 31	672	505	1,177	0.40%
September 30	938	639	1,577	0.50
1977 - March 31	1,772	947	2,719	0.79
September 30	2,236	1,155	3,391	0.92
1978 - March 31	3,195	1,456	4,651	1.19
September 30	3,783	1,741	5,524	1.34
1979 - March 31	4,886	2,070	6,956	1.59
September 30	5,623	2,410	8,033	1.77
1980 - March 31	6,566	2,532	9,098	1.94
September 30	7,488	2,766	10,254	2.10
1981 - March 31	8,693	3,000	11,693	2.30
September 30	9,564	3,152	12,716	2.51
1982 - March 31	12,578	3,452	16,030	3.05
September 30	15,055	3,739	18,794	3.50
1983 - March 31	19,434	4,022	23,456	3.91
September 30	23,859	4,524	28,383	4.37

Senator Huddleston—Continued

As indicated there was $23.9 billion in IRA's at these institutions on September 30, 1983 and $4.5 billion in Keogh Accounts.

Whether this is a fair share is a subject question. Last year, however, growth in combined IRA-Keogh balances was significantly slower at thrifts than at either commercial banks or in mutual funds (exclusive of money market funds), two of the other major holders of such accounts. The mutual fund growth rate was 83 percent, 74 percent for commercial banks, and 44 percent for thrifts.

MORTGAGE INSTRUMENTS

Question: What is the principal mortgage instrument now utilized by S&Ls — do long-term, fixed rate ones still predominate?

Answer: For 1983 as a whole, 42 percent of all conventional mortgage loans closed by savings and loan associations for purchasing single-family homes are estimated to have been adjustable rate loans, with the remaining 58 percent fixed-rate loans. These estimates, which are based on a continuing sample survey conducted by the Bank Board, are approximately the same as in 1982, when 43 percent of conventional home purchase lending was on variable rate instruments and 57 percent on fixed-rate instruments. The variable rate instrument share of association lending, however, rose sharply during the second half of last year, as associations began to offer significantly lower rates on variable loans, as opposed to fixed rate loans, and has exceeded 60 percent since November. For the most recent month available —March 1984 — the variable rate share was 66 percent. The maturity of most mortgages made by associations has remained long-term. The average term to maturity for fixed-rate loans last year was 26 years, and the average for variable rate loans was 27 years.

BANK MERGERS

Question: Is there any pattern — geographical, structural, size — to the disappearing institutions?

Answer: There are no real patterns as to the type of institutions although there were two basic areas identified —Texas where there were a lot of small state stock institutions, and Illinois.

Question: Are most troubled/disappearing institutions simply absorbed by a larger one? Does this suggest a trend toward larger institutions in order to insure healthy thrifts?

Answer: In most districts small supervisory institutions have generally been merged into larger institutions. In Texas, resolution has been through acquisition by individuals through Change of Control Notices.

The trend has been towards larger institutions which can offer more services, attract more highly qualified personnel, and be more competitive. While these factors should imply healthier institutions, it does not guarantee such, particularly if larger institutions already have mismatched asset/liability structures.

Senator Huddleston—Continued

Question: Can you make any rough projections regarding mergers for the rest of this year and fiscal 1985?

Answer: The total number of projected mergers are for remaining FY 1984: 134, and for FY 1985: 174.

QUESTION SUBMITED BY SENATOR LEAHY

USE OF PRIVATE ATTORNEYS

Question: What portion of the Federal Home Loan Bank Board (FHLBB) appropriation request is intended to pay for private attorneys to represent the FHLBB or Federal Savings and Loan Insurance Corporation (FSLIC) as plaintiffs in litigation and what criteria are used (1) to determine whether to hire private attorneys to represent the FHLBB or FSLIC and (2) to evaluate whether the costs of contracting out such representation of these agencies is justified by the recoveries obtained by such litigation?

Answer: None of the Board's budget subject to the limitations in its annual appropriation act have been used for this purpose. Such nonadministrative expenses have been incurred by the FSLIC and are excluded from the administrative limitations set in appropriation language. In calendar year 1983, FSLIC incurred nonadministrative expenses of $1.9 million for private attorneys in litigation. This was some 30 percent of the $6.4 million paid by FSLIC in 1983 for private fee counsel for all purposes.

Factors taken into account in determining whether to engage private attorneys include complexity of the case, estimated length of the litigation process and attorney-hours required, local laws involved, applicability of community standards of care, location of forum, location of records and other documents related to the case, workloads of Agency litigators, and whether special legal expertise is required.

Generally, because cases involving the FSLIC as plaintiff are of such complexity as to require a minimum of two to three attorneys and support staff, it has been concluded that the Bank Board's relatively small staff of litigators (8 attorneys and two paralegal assistants) is insufficient to assume primary litigation responsibilities for cases of this kind, which frequently are at long distances from Washington, D.C. Private attorneys in such cases are retained to pursue such litigation under the direct supervision of the Deputy General Counsel for Operations and the Litigation Division of the Office of General Counsel.

In response to part (2) of the question, the estimated costs of litigation in each case are weighed against potential recoveries. Estimates are difficult to make, given the uncertainties of litigation. However, there is a regular review of current and historical costs of each case, both by FSLIC staff and the

Office of General Counsel. In those recent cases in which recoveries have been achieved or where partial settlements with some defendants have been effected, returns to the Agency have been or are anticipated to be substantially in excess of counsel fees and costs of bringing the suit. Recoveries in 1983, net of litigation costs for cases finally settled, were $2,072,300. In 1984, we have had one final settlement netting $183,000 and a partial settlement grossing $1,150,000.

If private counsel had not been used in many of the cases, there would have been no recovery because the limited staff resources of the Agency would not have permitted initiation of the litigation.

In the last three years there has been no net loss on any suit initiated by the FSLIC.

SUBCOMMITTEE RECESS

Senator GARN. The subcommittee will stand in recess and reconvene on Tuesday, May 1, at 10 a.m. at which time we will hear testimony from the Department of Housing and Urban Development.

[Whereupon, at 11:25 a.m. Thursday, April 12, the subcommittee was recessed to reconvene at 10 a.m. Tuesday, May 1.]

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1985

TUESDAY, MAY 1, 1984

U.S. SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 10 a.m. in room SD–124, Dirksen Senate Office Building, Hon. Jake Garn (chairman) presiding.

Present: Senators Garn and D'Amato.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

STATEMENT OF SAMUEL R. PIERCE, JR., SECRETARY

ACCOMPANIED BY:

- **PHILIP ABRAMS, UNDER SECRETARY**
- **MAURICE BARKSDALE, ASSISTANT SECRETARY FOR HOUSING-FEDERAL HOUSING COMMISSIONER**
- **BENJAMIN BOBO, ACTING GENERAL DEPUTY ASSISTANT SECRETARY FOR POLICY DEVELOPMENT AND RESEARCH**
- **JACK STOKVIS, GENERAL DEPUTY ASSISTANT SECRETARY FOR COMMUNITY PLANNING AND DEVELOPMENT**
- **WARREN LINDQUIST, ASSISTANT SECRETARY FOR PUBLIC AND INDIAN HOUSING**
- **ALBERT J. KLIMAN, DEPARTMENTAL BUDGET OFFICER**

OPENING REMARKS OF CHAIRMAN

Senator GARN. The committee will come to order.

Mr. Secretary, it is a pleasure to welcome you here this morning to testify on your Department's fiscal year 1985 budget request.

Since we are only having a half a day of hearings this year, I am certainly not going to attempt to rehash or recover the same ground we already covered in several days of hearings before the Senate Banking Committee. Instead, my questions will be directed to those areas relevant to the appropriations process.

Mr. D'Amato?

Senator D'AMATO. Thank you, Mr. Chairman.

Mr. Secretary, it is a pleasure to have you before our subcommittee once again to present your 1985 budget request.

With passage of the Housing and Urban-Rural Recovery Act, housing policy in this country has taken a new direction. The legislation has reconciled divergent views on how to pursue the national objective of a decent home and a suitable living environment for every American family.

I am interested in hearing about the progress HUD is making in implementing the new programs and program adjustments mandated in Public Law 98-181. Only time will tell whether newly authorized programs such as vouchers, rental rehabilitation block grants, and housing development grants will be workable solutions to the very dire housing needs of lower income Americans.

Cost containment is the order of the day in most domestic programs of the Federal Government. Housing is no exception. However, the very basic need of a decent home for all of our citizens is an obligation the Federal Government cannot neglect.

I look forward to your testimony, Mr. Secretary, to shed light on how we will meet that obligation in fiscal year 1985 and in the outyears.

Senator GARN. Mr. Secretary, I note you have a rather lengthy statement. I would be happy to include the entire statement in the record and have you summarize it.

[The statement follows:]

STATEMENT OF SAMUEL R. PIERCE, JR.

Mr. Chairman and Members of the Committee:

With your approval, I will summarize my statement now and submit the full statement for the record. Once again, I am pleased to appear before you to present the 1985 Budget proposals of the Department of Housing and Urban Development. My essential message remains the same. The best way to provide effectively for the Nation's housing needs is to keep inflation under control and to bring interest rates down to reasonable levels.

Mr. Chairman, I am proud to say that we have done just that. Runaway inflation is no longer taxing away the purchasing power of the American homebuyer. For the great majority of the American people, the cost of housing is once again affordable. This is the key--affordability through a healthy economy.

During calendar year 1980, the annual rate of inflation was 12.4 percent. This was substantially reduced to 3.9 percent during 1982 and declined to 3.8 percent in 1983. In 1984, we expect this favorable economic trend to continue with, perhaps, only a slight increase in the inflation rate.

One important result is that the housing industry is building and Americans are buying. This can be seen in the housing starts figures. Public and private starts in calendar 1982 totaled less than 1.1 million. They increased to 1.7 million in 1983. We expect to sustain this progress during 1984. In fact, starts for the first quarter were 372 thousand. When seasonally adjusted, this first quarter activity would mean a 1984 total of more than 1.95 million. In addition, we estimate approximately 290,000 units of manufactured housing will be produced this year.

These indicators show a revitalized economy. But, we recognize that more can be done to make the dream of homeownership a reality for all Americans. To that end, the Reagan Administration has taken the lead in developing and encouraging innovative approaches to mortgage financing. In particular, we are implementing a wide range of programs, authorized by the 1983 authorization act, designed to target insurance and credit to first time homebuyers, inner-city residents, rural areas and Indian lands. In many cases, these new programs will make financing available, and affordable, to families who are currently unable to purchase a home of their own.

Of course, homeownership is not possible for all. This Department has a special responsibility to help meet the rental housing needs of particular segments of society--the elderly, the handicapped, and the poor. Our challenge is to meet these needs creatively and effectively in an environment of competing demands for limited Federal resources. One of the goals of the Reagan Administration is to reduce Federal spending, but budget trimming need not mean less assistance to needy families. Indeed, this Administration believes that by using the existing supply of rental housing, and providing incentives to families and communities, we can adequately house a greater number of people at significantly reduced cost.

That is why, for 1985, we propose incremental assistance for some 87,500 families under the Housing Voucher Program. The Voucher program evolved from the Experimental Housing Allowance program, and is based on the Section 8 Existing Housing program. It thus has a long history of both solid research and practical testing in a successful ongoing program. We do not believe that further testing is required. We know that vouchers will work. Moreover, the Voucher program provides the only means of meeting the need for housing subsidies at a reasonable cost.

We have made sure that the subsidy provided under our new program is sufficient to meet the cost of obtaining decent housing. The long term budget authority reserved for a Voucher unit is lower than a comparable amount under Section 8 existing because of differences in contract term and the mechanism for funding future rent increases. But, we expect the first year cost to be virtually identical under both programs. The real difference is that we are replacing a subsidy mechanism that builds in future rent increases with one that gives an incentive to limit future rent escalation. Thus, there will be savings but they will only occur over time. We are proposing full implementation of the Voucher program because we feel it is a better program--not as a way of reducing outlays in the short-run.

Our basic premise is that sufficient units are available Nationwide to provide shelter for most needy families. The best way to assist these families is through an income supplement which improves their purchasing power. A unique feature of the voucher approach is that it provides a shopping incentive: the family can spend less than the level of assistance and pocket the difference; or it can choose to spend more of its own resources if it values housing more highly.

We believe strongly that the voucher approach is the way to proceed in the future. Our estimates show that we can house about three times as many families with vouchers as with previous new construction programs. But, we also recognize the unique needs of certain groups--the elderly, the handicapped, Indians, and large families--for new construction or rehabilitation. We also recognize that there are pockets of shortage in certain areas. Thus, our Budget request includes funding for Section 202 new construction, Indian Public Housing, and two new grant programs of rental housing construction and rehabilitation. The result is a comprehensive approach which relies primarily on vouchers, but also makes use of construction and rehabilitation programs where needed.

In fiscal year 1984, we propose to implement the Rental Rehabilitation and Rental Housing Development Grant programs. These are both designed to increase the supply of standard rental housing. The Rental Rehabilitation Grant program will make grants available to States and local governments to support the moderate rehabilitation of rental housing. Generally, this would involve rehabilitation costs of up to $10,000 per unit. The Federal grant share would represent 50 percent of the rehabilitation cost, or up to $5,000, with possible adjustments for high cost areas. The level of rehabilitation, however, would be at the discretion of the grantee. Participating States and local governments would be responsible for selecting projects and administering the program, which will emphasize providing units for large families.

A $150 million funding level annually is proposed for fiscal years 1984 and 1985, to rehabilitate approximately 30,000 rental units each year. Tenants who live in units to be rehabilitated, or who move into the units, may also be eligible for the Housing Voucher and Section 8 Existing programs. The interim regulations implementing the Rental Rehabilitation program have been published.

Our proposed Rental Housing Development Grant program will make Federal grants available to State and local government for specific new construction and substantial rehabilitation projects. As provided in the authorizing legislation, project eligibility would take into account severe shortages of decent rental housing and a lack of affordable alternatives.

The proposed funding level for the Rental Housing Development program is $200 million in 1984 and $115 million in 1985, for construction or substantial rehabilitation of up to 10,000 and 6,000 units respectively. These unit estimates are subject to change, since some of the key program design issues are still being worked out. Because of the lead time required for implementation of this new construction program, the initial project completions are not anticipated until fiscal year 1986. We expect to submit the proposed regulations for the Development program to Congress shortly.

HIGHLIGHTS OF 1985 BUDGET REQUEST

Now, Mr. Chairman, I will highlight the key figures and proposals included within our Budget request.

Net budget authority of $10.5 billion is requested for 1985. This includes $12.5 billion in new budget authority, offset by $2 billion in rescissions under the Section 236 and Rent Supplement programs. The $10.5 billion figure is about $3.2 billion less than the 1984 budget authority estimate of $13.7 billion. This decrease is the result, primarily, of lower requirements for the Subsidized Housing programs because of the savings made possible by initiation of the Housing Voucher program.

Another factor contributing to the need for lower budget authority in 1985 is that all budget authority for the Rental Housing Development and Rental Rehabilitation Grant programs--for both 1984 and 1985--is being requested in 1984.

Net outlays are projected at $15.2 billion in 1985, based on gross disbursements of $21.8 billion offset by loan repayments, asset sales, and other revenue of $6.6 billion. The $15.2 billion estimate is $650 million less than the 1984 outlay estimate. This reduction reflects higher premium receipts and sales of acquired properties under the FHA Mortgage Insurance Programs, and a substantial decrease in the GNMA Tandem program since the majority of purchases under the now-terminated program will have occurred in 1984. The savings will partly offset the outlay increases in our Subsidized Housing programs. Most other programs are expected to spend at about the same levels as in 1984.

Full-time permanent employees will decline to 11,910 in 1985, a reduction of 187 from the proposed 1984 level of 12,097 and 517 from the 1983 level of 12,427 positions. The reduced staffing reflects improved management practices, streamlined operating procedures, and the use of contractual services, where appropriate.

The proposed 1985 Budget Authority of $6.3 billion for the Department's Subsidized Housing programs includes funding for 87,500 incremental Vouchers. We are also proposing 12,500 new construction units, consisting of 10,000 units for the elderly and handicapped under the Section 202 program and 2,500 Indian Housing units. This brings our total incremental housing assistance in 1985 to 100,000 units.

We are requesting budget authority of $1.1 billion for Public Housing Operating Subsidies and $1.55 billion for the Modernization of existing Public and Indian housing units. The latter figure would support approximately $761 million of capital and management improvements for these valuable housing assets. This represents a continuing effort to renovate the existing stock through our Comprehensive Improvement Assistance Program.

Our Budget request includes $3.5 billion for the Community Development Block Grant program--the same level as appropriated in 1984. For the Urban Development Action Grant program, we are proposing an appropriation of $440 million, also the same level as 1984. No changes are proposed in the authorizing legislation for either of these programs. We believe both are working well, and the effects of the 1983 amendments should be analyzed before further amendments are proposed. Let me reiterate the continuing commitment of this Administration to help States and local communities meet their community and economic development needs through the CDBG and UDAG programs.

The Urban Homesteading program is being expanded to include demonstrations for the homesteading of FHA-owned multifamily properties and locally-owned one-to-four unit properties. These demonstrations will be funded within a total appropriation of $12 million in each of fiscal years 1984 and 1985.

The Budget also requests $6.7 million for the Fair Housing Assistance program, an increase of $2 million over 1984. This increase reflects our commitment to enforcement of fair housing and the prompt processing of Title VIII complaints. In 1985, we will emphasize outreach efforts to increase public awareness of the purposes of Title VIII and other civil rights mandates. Finally, the Budget proposes $20.9 million for research. I urge the Committee to consider this request favorably so we can meet the new research responsibilities mandated by the 1983 authorization.

Mr. Chairman, none of our 1984 or 1985 Budget requests require enactment of authorizing legislation. The major housing and community development initiatives of the Reagan Administration involving Federal financial assistance have already been enacted into law. Only appropriation action is now required.

However, two initiatives remain which have not yet been passed by Congress--Enterprise Zones and our Fair Housing Amendments. Although this Committee does not have jurisdiction over these proposals, I take every available opportunity to urge their speedy passage. The Enterprise Zone legislation is needed because of its importance as an economic development tool. The Fair Housing Amendments should be enacted to strengthen the fair housing enforcement powers of the Federal Government.

Also, Mr. Chairman, the Budget reflects an organizational change of the Department's Housing programs. We have established, as you know, a new Assistant Secretary for Public and Indian Housing--Warren Lindquist. All other Housing programs, including the Mortgage Insurance Programs, are the responsibility of Maurice Barksdale, the new FHA Commissioner, who also is with me here today.

Mr. Chairman, this concludes a summary of my opening statement. I would like to insert the full statement in the record and will be happy to respond to any questions you may have.

SUBSIDIZED HOUSING

As noted, we made an organizational change last year and established a new Assistant Secretary for Public and Indian Housing. At this time, I will focus on the programs currently being administered by the Assistant Secretary for Housing/FHA Commissioner and address those housing programs transferred to the new Assistant Secretary later in my discussion.

Increased Assistance. I am expecting the number of families assisted under the Department's Subsidized Housing programs to increase greatly over the next several years. By the end of 1981, approximately 3.3 million housing units were receiving assistance under the Department's housing programs and our projections are that this number will grow to almost 4 million by the close of 1985 and to about 4.4 million units by the end of 1989.

Budget Request. The Budget for 1985 proposes the release of $6.24 billion of new budget authority. This new authority, in addition to $2.75 billion of recaptured budget authority, a carryover of $82.5 million from 1984 and permanent authority amounting to $22.3 million, will allow us to carry out a $9.1 billion dollar program for 1985 in support of 150,594 Section 8 and Public Housing units.

Housing Vouchers. Authorized in the Housing and Urban-Rural Recovery Act of 1983 as a demonstration program, we are looking to Housing Vouchers to provide a major portion of our assistance to low-income families for 1985. Of the 150,594 Section 8 and Indian Housing unit reservations proposed for 1985, 91,000 will take the form of Housing Vouchers (including 87,500 incremental vouchers).

Subsidy costs will be reduced appreciably by this attempt to promote greater utilization of the existing housing market. I must point out that, in addition to being cost effective, this approach also offers greater mobility and flexibility to program beneficiaries.

A "payment standard" will be established under the program, equal to the Section 8 Fair Market Rent for Existing Housing, which is based on the rental cost in a particular area of modestly priced standard housing of various sizes and types. This standard will be used, in combination with appropriate data about family income and composition, to determine the Federal subsidy amount to be provided. Two adjustments to the subsidy amount, over the 5 year ACC term, may be made at the discretion of the Public Housing Authority which is responsible for administering the program.

Use of a payment standard as a basis for subsidy determination rather than as a cap on housing cost will give program participants the option of paying more for rental housing--if they choose to do so. No longer will their options be limited to units at or below a "Fair Market Rent" established for particular local housing market areas. As I mentioned earlier, a family can also choose to pay less rent and pocket the difference.

Units will be made available under the Voucher program in a number of ways, including:

- to assist new families (incremental units);
- to replace those Section 8 certificates that would have been issued this year due to normal turnover;
- for tenants of Public Housing projects which are sold or demolished; and
- for tenants of Section 8 new construction or substantial rehabilitation projects displaced when owners fail to renew their contracts.

Incremental Units. As I said, the number of families we will assist under the Subsidized Housing programs is going to grow. Our commitment to this course of action is manifested in the fact that the 150,594 unit reservations proposed for 1985 include 100,000 incremental units, and the remainder of the new reservations are for units already assisted in some fashion. Of the 100,000 newly assisted units, 87,500 will be Voucher units, 2,500 are to be Public Housing units for Indian families and 10,000 are to represent Section 8 new construction and substantially rehabilitated units used in support of the Section 202 program to help house the elderly and handicapped. Furthermore, it is expected that some of these incremental voucher units will be used in conjunction with the new Rental Rehabilitation Grant Program.

Continued Support. In addition to these 100,000 incremental units, Section 8 subsidies will be provided for special purpose set-asides and a number of units already being assisted under current subsidy programs. These include such Section 8 Existing set-asides as loan management (5,000 units) property disposition (5,000 units); Section 23 conversions (5,000 units); conversion of Rent Supplement/

Section 236 units (32,094 units); as well as 3,500 Vouchers directed toward tenants of demolished or sold Public Housing units and residents of units in projects which no longer participate in the Section 8 program.

An estimated 160,000 Vouchers will be available for those Section 8 Existing Certificates expected to be relinquished during 1985. These units are not included within our reservation totals because they will be funded within the current contract authority and no new funding will be required for those Vouchers until the existing contracts expire.

RENTAL HOUSING DEVELOPMENT GRANTS

There will be some situations--some localities--where a satisfactory supply of safe, decent housing may not exist. To cover this contingency, I am proposing that two recently authorized programs of housing construction and rehabilitation be implemented. In 1984, $615 million is proposed for transfer from the Annual Contributions account in support of the Rental Housing Development Grant and Rental Rehabilitation Grant programs in 1984 and 1985. The development program is to be administered by the Assistant Secretary for Housing and the rehabilitation program will be administered by the Assistant Secretary for Community Planning and Development.

Under the Rental Housing Development Grant program, States, cities and urban counties would select developers interested in constructing or substantially rehabilitating privately-owned multifamily rental housing and would provide funding to the developers in the form of loans, interest reduction payments, or other types of financial assistance. Project eligibility would take into account location factors, such as severe shortages of decent rental housing and a lack of other affordable housing alternatives. The proposed funding level for the program is $200 million in 1984 and $115 million in 1985, which, depending on location and costs, would support the construction or substantial rehabilitation of up to 10,000 and 6,000 units, respectively. These estimates may be revised once all program design issues are resolved.

HOUSING FOR THE ELDERLY OR HANDICAPPED

The Budget proposes loan reservations of $500 million in 1985 for the Section 202 Housing for the Elderly or Handicapped program. This is expected to support 10,000 new or substantially rehabilitated units in conjunction with the Section 8 program. The Budget assumes these loans will be offered at the same interest rates as outstanding Treasury borrowings plus a 1/4 of one percent administrative fee.

NONPROFIT SPONSOR ASSISTANCE

No appropriation is being requested for the Nonprofit Sponsor Assistance program since loan amounts can be funded from repayments of prior year loans. However, a loan limitation of approximately $1.9 million for 1985 is being requested in order to enable the Department to continue to carry out a limited program to assist sponsors of Section 202 projects.

HOMEOWNERSHIP ASSISTANCE

We are not proposing any new appropriations in 1985 for the Section 235 Homeownership Assistance program. Balances of authority remaining available will lapse, except for amendments to contracts reaching insurance endorsement. The subsidy reservation phase of the current program expired on November 30, 1983 and the Department is not proposing to implement the restructured program authorized in the Housing and Urban-Rural Recovery Act of 1983.

RENT SUPPLEMENT PROGRAM

The 1985 Rent Supplement program includes the anticipated recapture of an estimated $86.6 million of contract authority and $1.8 billion of budget authority as a result of the expected conversion of up to 34,372 insured Rent Supplement units to Section 8 assistance. All but $5 million of these recaptures are being proposed for rescission.

The conversion of Rent Supplement assisted units to Section 8 assistance provides a long-term solution to the existing problem of inadequate funding to amend contracts for projects with Rent Supplement units. The approximately $5 million of recaptures, not being proposed for rescission, will be utilized to provide necessary rent increases for the insured Rent Supplement units which are not scheduled for immediate conversion to the Section 8 program. The State-aided projects will continue to receive needed amendments in accordance with the 1983 Supplemental Appropriations Act and as authorized by the Housing and Urban-Rural Recovery Act of 1983.

RENTAL HOUSING ASSISTANCE

The Budget proposes that during 1984 and 1985 the Department will convert the remaining 18,000 Rental Assistance Program (RAP) units in insured projects to the Section 8 program. Non-insured State-aided projects will be exempted from the conversion policy and will continue to receive subsidy assistance and necessary amendments in accordance with the 1983 Supplemental Appropriations Act and as authorized by the Housing and Urban-Rural Recovery Act of 1983.

The conversion of RAP units will result in the recapture of contract authority ($8.6 million) and budget authority ($192.0 million). A small amount of this authority will be utilized to provide needed amendments to units not yet converted, and remaining balances of authority will be proposed for rescission.

HOUSING PAYMENTS

For 1985, the Budget proposes that a permanent indefinite appropriation be enacted for each of the separate programs covered under the current "Housing Payments" consolidated appropriation. The appropriation covers liquidation payments for subsidized Housing programs and includes subsidy payments for Section 8, Public and Indian Housing, Section 235, Section 236, Rent Supplement and College

Housing debt service grants. The request for permanent indefinite authority will simplify accounting for the programs and ensure that the amount of the appropriation will never be higher or lower than the exact amount needed to liquidate the payment commitments for units placed under contract in accordance with prior acts of Congress. It is estimated that $11.7 billion in liquidation requirements will be needed in 1985 to cover contracts outstanding on about 4 million units eligible for payment during the year.

MORTGAGE AND LOAN INSURANCE

The Budget recognizes the importance to the economy of a healthy housing industry and proposes to continue to provide a substantial level of credit support to this sector. The Budget proposes a $50.9 billion limitation on gross commitments for mortgage and loan insurance in 1985, although we expect to commit $40.9 billion to support insurance applications for 840,000 single family homes, 96,000 multifamily units, and 240,000 insured Title I loans during 1985.

In addition, the Congress has enacted a wide range of programs which are designed to better focus the mortgage insurance activities of the Federal Government to those groups, specifically first-time homebuyers and inner-city residents, who cannot be fully served by the private market. The implementation of these programs will result in an expansion in homeownership opportunities for these groups by complementing the activities already underway in the conventional market.

Specifically, we are planning to implement programs to provide insurance for new financing mechanisms including Adjustable Rate Mortgages (ARMs), Shared Appreciation Mortgages (SAMs) and Indexed Mortgages. The Congress also eliminated the Secretary's authority to set interest rate ceilings for insured loans.

We also are proposing a direct loan limitation of $65.4 million under the Temporary Mortgage Assistance Payments (TMAP) program for 1985 for payments on behalf of homeowners who have suffered temporary loss of income due to circumstances beyond their control. We expect that this program will commence this Summer.

To reimburse the General Insurance and Special Risk Insurance Funds for actual losses experienced in 1983, we are requesting a $388 million appropriation in 1985. This appropriation is necessitated because of mortgage and loan insurance claims. The appropriation will be used also for other operating expenses in 1985 and to repay part of the outstanding Treasury borrowings. As you know, these appropriations have allowed the Department to hold the line on additional Treasury borrowings over the years and thereby reduce the steep rise in interest costs to the FHA Fund. This has helped to ensure the financial soundness of the Fund.

TROUBLED PROJECTS/FLEXIBLE SUBSIDY PROGRAM

Funding for the Troubled Projects/Flexible Subsidy program will be provided in 1985 by using unobligated balances estimated to be carried over from 1984 and transfers from the Rental Housing

Assistance Fund. No new appropriation is requested. These funds will be used to address the comprehensive needs of an estimated 133 financially troubled projects in 1985 and keep them from going into default and/or foreclosure.

PUBLIC AND INDIAN HOUSING

PUBLIC AND INDIAN HOUSING DEVELOPMENT PROGRAMS

Consistent with our policy of attempting to meet low-income housing needs through the Section 8 Housing Voucher program whenever feasible, we are not proposing to fund additional Public Housing construction in 1985. However, we recognize the fact that additional new construction may be needed to help house the Indian and Alaskan Native populations and our Budget for 1985 includes $391 million of budget authority to be used to support the funding of 2,500 Indian Housing units. In addition, we will continue to honor our commitment to assist those financially feasible public housing projects which are in the pipeline. The Budget includes $300 million of budget authority for use in amending Public and Indian Housing contracts. This will provide additional authority for those Public Housing projects which still remain in the development pipeline. A portion of this authority also will be utilized for Indian Housing off-site water and sewer projects as well as to correct design and construction deficiencies to various Indian Housing projects.

PUBLIC AND INDIAN HOUSING MODERNIZATION

The 1985 Budget for Annual Contributions for Assisted Housing also reflects the use of $1.55 billion of budget authority for Public and Indian Housing Modernization which is performed under the Comprehensive Improvement Assistance Program (CIAP). This funding level will finance an estimated $761 million of capital costs as a part of our goal to improve both the physical condition of this valuable stock of housing and improve the management activities which support the operation of the projects.

PUBLIC AND INDIAN HOUSING LONG-TERM FINANCING

The Budget proposes the use of $907 million of budget authority in 1985 for interest rate adjustments to permit the sale of $1.2 billion of permanent financing instruments to the Federal Financing Bank (FFB). This long-term financing will begin to replace short-term financing of development and modernization costs of Public and Indian Housing under existing annual contributions contracts. The plan to market instruments to the FFB is consistent with the Administration's government-wide credit management policy and allows the FFB to coordinate governmental financing needs.

PAYMENTS FOR OPERATION OF LOW-INCOME HOUSING PROJECTS

An appropriation of $1.1 billion is requested in 1985 for Operating Subsidies for Public and Indian Housing to support the operation of dwellings by Public Housing Agencies and Indian Housing Authorities. The estimate is based, primarily, upon the use of the Performance Funding System (PFS) formula in calculating operating subsidy requirements. The appropriation request reflects the implementation of enacted legislation increasing the maximum allowable rent levels for tenants and a revised definition of adjusted income. The estimate also assumes revised operating subsidy calculations based on the impact of a "rolling base" utility consumption level, income adjustments to reflect actual income received, and limiting payments in cases of excessive vacancy levels.

Because resources available for 1984 are in excess of funding requirements for the year, the Budget proposed a rescission of $331.4 million for 1984. This proposal was not approved by the Congress.

GOVERNMENT NATIONAL MORTGAGE ASSOCIATION

MORTGAGE-BACKED SECURITIES PROGRAM

Mr. Chairman, I would now like to discuss the programs of the Government National Mortgage Association.

We propose the continuation of the limitation on the Mortgage-Backed Securities Program in 1985 at a level of $68.25 billion of commitments issued, and we expect $42 billion of issues guaranteed.

The proposed commitment level is the same as the limitation included in the 1984 appropriation act. The level proposed for 1985 is realistic based upon the estimated levels of loans projected to be actually insured by FHA or guaranteed by VA in 1985. It should be noted that the calculation of the requested commitment limit is based on a mathematical relationship, between FHA and VA volume and GNMA activity.

DEBT FORGIVENESS

The Housing and Urban-Rural Recovery Act of 1983 repealed GNMA's authority to issue new commitments under the Special Assistance Functions and the Emergency Mortgage Purchase Assistance programs, and places both programs into a liquidation status. We are proposing appropriation language for fiscal year 1985 to: (1) forgive all outstanding Treasury borrowings issued under these programs effective October 1, 1984; and (2) transfer all remaining assets and liabilities of the program to the Management and Liquidating Functions Fund under the FNMA Charter Act. We view the latter proposal as a housekeeping matter.

Approval of debt forgiveness will eliminate the requirement for interest payments due the Treasury and, as a result, reduce the outlay and budget authority requirements of the Department in 1985 and future years. The outlay savings from debt forgiveness in 1985 are estimated at $1,212.5 million under the Tandem Program and $271 million for the Emergency Mortgage Purchase Assistance Program. Any receipts collected as a result of portfolio liquidation would be returned to the U.S. Treasury.

It must be noted that the projected outlay savings to the Department under the Debt Forgiveness proposal will not result in any reduction in the Federal deficit. This is because the reduction in Departmental outlays, resulting from reduced interest payments, is offset by an equivalent reduction in the amount of interest collected by the Treasury.

Debt forgiveness permits the Federal accounts to be adjusted in recognition that debt being cancelled cannot be repaid. The inability to pay off the debt does not represent a failure, but rather was inherent in the original program design.

SOLAR ENERGY AND ENERGY CONSERVATION BANK

Moving now to the Solar Bank, the Budget proposes that no additional budget authority be enacted for the Solar Bank program in 1985.

For those funds already appropriated, the Department has taken the necessary steps to implement the program effectively through the States and to make the Solar Bank operable. During 1983 the Department obligated all of the fiscal year 1982 appropriation, as directed by court order, as well as $8.5 million of the 1983 appropriation. These funds are now with the States and it is up to interested individuals to make use of them.

The Department now intends to obligate the remainder of the 1983 appropriation and all of the 1984 appropriation (except a small amount for 1985 salaries and expenses of the Bank) by the end of fiscal year 1984.

COMMUNITY PLANNING AND DEVELOPMENT

COMMUNITY DEVELOPMENT BLOCK GRANTS

For the Community Development Block Grant program, we are requesting $3,468 million, the full amount authorized. Within this amount, we expect to use $56.5 million for funding activities under the Secretary's Discretionary Fund. The major categories of activities under this fund are grants to Indian tribes and insular areas, and the provision of technical assistance to states and units of local government to assist them in making the most effective use of their CDBG funds.

The remaining Block Grant funds, nearly $2.4 billion for entitlement cities and counties and just over $1 billion for the State Small Cities program, represent a slight funding increase of $12 million. These funds will assist grantees in building economically and socially viable communities. Entitlement funding in 1985 is expected to assist 706 metropolitan cities and an estimated 104 urban counties in furthering the national objectives set forth under Title I of the 1974 authorizing act. These communities use their grant funds to upgrade their housing stock, expand economic opportunities for their citizens and improve their public facilities and services. Of particular significance is the way States are using the Block Grant program to expand opportunities for new jobs and to establish new linkages with the private sector. The request of $1 billion will provide support for 50 States, plus Puerto Rico, under the Small Cities program.

Changes to the authorizing legislation late last year now require that States and entitlement communities use a majority of their CDBG funds for activities that benefit low- and moderate-income persons. The Department has communicated the new requirement to grantees and will be amending program regulations accordingly.

The Department is recommending 1985 appropriation language to prohibit grantees, which operate revolving funds for rehabilitation activities, from receiving their Block Grant funds in a single payment. Currently, grantees may draw down such funds in a lump sum when they are used exclusively for rehabilitation activities. The Department has concluded that such payments are not necessary to attract private financing, in conjunction with CDBG assisted rehabilitation, and that lump sum drawdowns constitute an unwarranted increased cost to the Federal Treasury.

All block grant recipients are expected to maximize benefits from CDBG funds by utilizing other local public and private resources. In this endeavor, recipients are encouraged to continue to establish and maintain local public/private partnerships.

URBAN DEVELOPMENT ACTION GRANTS

The benefit of such partnerships is demonstrated in the popular UDAG program which uses Federal dollars to leverage other public and private resources for economic development projects in distressed areas. In a recently released report entitled "Insights into Major Urban Development Action Grant Issues," the General Accounting Office provided a very favorable review of the program's effectiveness in accomplishing its economic development objectives.

Currently, Action Grants are leveraging approximately $5.70 for each dollar of Action Grant funds awarded. This program has been instrumental in creating new permanent jobs, retaining jobs that otherwise would be lost, and providing construction jobs. The average cost for each job created is approximately $7,500. Local governments can count on this program to stimulate additional property and other tax revenues. For 1985, we are requesting an appropriation of $440 million to continue this highly successful program.

URBAN HOMESTEADING

We believe that the Urban Homesteading program is another effective method to improve existing housing stock and promote neighborhood revitalization. Therefore, we are proposing a $12 million appropriation in 1985. Of this amount, $3 million is to be used for the multifamily homesteading demonstration authorized in the Housing and Urban-Rural Recovery Act of 1983. This demonstration will be used to spur local interest in addressing the problem of deteriorated multifamily housing stock through the homesteading of HUD-held multifamily properties.

We expect the remaining $9 million of this appropriation to support the conveyance and homesteading of 726 single family units, at an average of $12,400 each through the regular Urban Homesteading program and through the local property demonstration program, also authorized by the 1983 Act. This latter program is authorized at not to exceed $1 million in each of fiscal years 1984 and 1985.

RENTAL REHABILITATION PROGRAM

The Rental Rehabilitation program is likewise authorized by the Housing and Urban-Rural Recovery Act of 1983. This program is designed to support the voucher and Section 8 certificate programs by increasing the supply of standard housing available to lower-income tenants through moderate rehabilitation of existing units.

Assistance will be provided to States and units of general local government on a formula allocation basis for rehabilitation of privately-owned, primarily rental residential properties, located in lower income neighborhoods. In each of fiscal years 1984 and 1985, $150 million will be made available for rehabilitation grants via a transfer of $300 million in 1984 from the Annual Contributions for Assisted Housing account. This transfer has been proposed in our 1984 supplemental appropriation request. In addition, Section 8 Existing Housing certificates and vouchers will be allocated in conjunction with this program in each of fiscal years 1984 and 1985. With additional funds from other public/private sources, we expect an estimated total rehabilitation effort of $300 million in each year.

This program represents a new approach to coordinating production subsidies with rental assistance, thereby using rather than replacing the free market. We anticipate that this approach will produce over 30,000 affordable units annually.

TERMINATED PROGRAMS

Our 1985 Budget proposals call for the termination of both the Section 108 Loan Guarantee and Section 312 Rehabilitation Loan programs. We are again recommending the termination of the Section 108 Loan Guarantee program in support of the Administration's overall effort to reduce market disturbances caused by Federal guarantees. We also recommend termination of the Section 312 program, as it is being replaced with the more effective and efficient Rental Rehabilitation Grant program.

As of December 31, 1983, the assets and liabilities of the New Communities Fund were transferred to the Revolving Fund for Liquidating Programs. The Assistant Secretary for Community Planning and Development is now responsible for the close-out of remaining New Communities projects.

POLICY DEVELOPMENT AND RESEARCH

An appropriation of $20.9 million is requested in 1985 for the Research and Technology account to carry out the Department's research program. We will continue to emphasize the improvement of the efficiency, and effectiveness of the Department's programs as well as the development of practical alternatives to these programs.

Particular areas on which we will continue to focus include:

- strategies for increasing the efficiency and effectiveness of assisted and public housing programs through reforms of existing programs and evaluation of alternative programs;
- analysis of housing finance issues, including the relationship between tax policies and housing; the effect of financial institution regulation and reform; and the development of alternative ways to finance housing;
- issues related to fair and nondiscriminatory housing;
- identification of new ways to promote housing affordability by reducing the component costs of housing (costs of development, building, financing, and operating);
- the development of improved techniques for the management of communities and for the delivery of local government services, and the identification of programs and techniques successfully used by neighborhood organizations; and
- urban policy development research including studies of urban change, capital investment patterns by cities, and research on new or improved approaches to urban economic development; and the impact of Federal tax and grant policies on central cities.

In addition, there are major new evaluation responsibilities which must be carried out in response to the mandates contained in the Housing and Urban-Rural Recovery Act of 1983. These include evaluations of the Housing Voucher program, the Rental Rehabilitation Grant program, and the Rental Housing Development Grant program. Moreover, we plan to conduct a number of evaluations of other programs and demonstrations created by the 1983 Act, including: Alternative Mortgage Instruments for single and multifamily housing, negotiated interest rates for FHA insured mortgages, multifamily homesteading, and others.

FAIR HOUSING AND EQUAL OPPORTUNITY

We are requesting $6.7 million for the Fair Housing Assistance program which includes assistance for substantially equivalent State and local agencies and Community Housing Resource Boards. Of this total, $4.7 million will provide for the capacity building of State and local agencies recognized by HUD as substantially equivalent under Title VIII of the Civil Rights Act of 1968 and to reimburse those agencies for complaints actually processed. This amount for State and local agencies represents an increase of $1 million and is necessary due to an increase in complaint activity and for additional agencies coming into the program.

The remaining $2.0 million will provide training and technical assistance to Community Housing Resource Boards (CHRBs). Community Housing Resource Boards assist the Department in developing and implementing Voluntary Affirmative Marketing programs. The increase of $1.0 million restores the funding to its pre-1984 level. The

CHRB funding, together with funding for State and local agencies, provides an effective alternative which allows States and local agencies and private groups to form a partnership with HUD in enforcing the Fair Housing Law.

In 1985, we will also conduct outreach through the funding of local fair housing and/or civil rights groups to increase public awareness of the purposes, rights and remedies that exist under civil rights mandates.

We will also emphasize the full implementation of Section 504 of the Rehabilitation Act of 1973 as it relates to nondiscrimination on the basis of handicap in HUD-assisted programs. This includes training of HUD staff, providing technical assistance to HUD recipients to assist them in complying with Section 504, and providing information to disabled persons and groups to help them participate in HUD programs and acquaint them with their rights.

In 1985, we are also requesting an additional 23 positions consisting of 3 at Headquarters and 20 in the Field. The additional Headquarters' positions are for increased workload in the area of Title VIII and to provide additional support to the Community Housing Resource Boards program. The twenty additional Field positions are for the enforcement of Section 504 and the Age Discrimination Act of 1975.

DEPARTMENTAL MANAGEMENT

Our 1985 funding request for Salaries and Expenses is $586.2 million, a decrease of $3.4 million from the current 1984 estimate of $589.6 million. The 1984 estimate includes a request for a $7.5 million pay raise supplemental.

The major reason for the decrease in the funding request is due to a reduction in staff requirements. Our 1985 staffing request is for 11,910 full-time permanent personnel, a decrease of 187 from the 1984 estimate of 12,097. The decrease consists principally of a reduction of 148 positions in the area of Departmental Management. The balance of 39 positions is the net effect of a reduction of 92 positions for housing programs, including Public Housing, partially offset by an increase of 53 for community development and fair housing activities.

SUMMARY OF STATEMENT

Senator GARN. Please proceed.

Secretary PIERCE. Thank you, Mr. Chairman. With your approval, I will summarize my statement at this time.

Once again, I am pleased to appear before you to present the 1985 budget proposals of the Department of Housing and Urban Development. My essential message remains the same. The best way to provide effectively for the Nation's housing needs is to keep inflation under control and to bring interest rates down to reasonable levels. Mr. Chairman, I am proud to say we have done just that. Runaway inflation is no longer taxing away the purchasing power of the American homebuyer. For the great majority of the American people, the cost of housing is once again affordable. This is the key, affordability through a healthy economy.

During calendar year 1980, the annual rate of inflation was 12.4 percent. This was substantially reduced to 3.9 percent during 1982 and declined to 3.8 percent in 1983. In 1984 we expect this favorable economic trend to continue with perhaps only a slight increase in the inflation rate.

HOUSING STARTS

One important result is that the housing industry is building and Americans are buying. This can be seen from the figures on housing starts. Public and private starts in calendar year 1982 totaled less than 1.1 million.

They increased to 1.7 million in 1983. We expect to sustain this progress during 1984. In fact, starts for the first quarter were 372,000. When seasonally adjusted, this first-quarter activity would mean a 1984 total of more than 1.95 million. In addition, we estimate approximately 290,000 units of manufactured housing will be produced this year. These indicators show a revitalized economy, but we recognize that more can be done to make a dream of homeownership a reality for all Americans.

NEW MORTGAGE FINANCING METHODS

To that end, the Reagan administration has taken the lead in developing and encouraging innovative approaches to mortgage financing. In particular, we are implementing a wide range of programs authorized by the 1983 Authorization Act designed to target insurance and credit to first-time homebuyers, inner-city residents, rural areas, and Indian lands. In many cases, these new programs will make financing available and affordable to families who are currently unable to purchase a home of their own.

NEED FOR RENTAL HOUSING

Of course, homeownership is not possible for all. This Department has a special responsibility to help meet the rental housing needs of particular segments of society—the elderly, the handicapped, and the poor. Our challenge is to meet these needs creatively and effectively and in an environment of competing demands for limited Federal resources. One of the goals of the Reagan administration is to reduce Federal spending, but budget trimming need not mean less assistance to needy families.

HOUSING VOUCHERS

Indeed, this administration believes that by using the existing supply of rental housing and providing incentives to families and communities, we can adequately house a greater number of people at significantly reduced costs. That is why for 1985 we propose incremental assistance for some 87,500 families under the housing voucher program. The voucher program evolved from the experimental housing allowance program and is based on the section 8 existing housing program. It, thus, has a long history of both solid research and practical testing in a successful ongoing program. We do not believe that further testing is required. We know that vouchers will work. Moreover, the voucher program provides the only means of meeting the need for housing subsidies at a reasonable cost.

We have made sure that the subsidy provided under our new program is sufficient to meet the cost of obtaining decent housing. The long-term budget authority reserved for a voucher unit is lower than a comparable amount under section 8 existing because of differences in contract terms and the mechanism for funding future rent increases. But we expect the first-year costs to be virtually identical under both programs. The real difference is that we are replacing a subsidy mechanism that builds in future rent increases with one that gives an incentive to limit future rent escalation. Thus, there will be savings, but they will only occur over time. We are proposing full implementation of the voucher program because we feel it is a better program, not as a way of reducing outlays in the short run.

Our basic premise is that sufficient units are available nationwide to provide shelter for most needy families. The best way to assist these families is through an income supplement which improves their purchasing power. A unique feature of the voucher approach is that it provides a shopping incentive. A family can spend less than the level of assistance and pocket the difference, or it can choose to spend more of its own resources if it values housing more highly.

We believe strongly that the voucher approach is the way to proceed in the future. Our estimates show that we can house about three times as many families with vouchers as with previous new construction programs. But we also recognize the unique need of certain groups—the elderly, the handicapped, Indians, and large families—for new construction and rehabilitation. We also recognize that there are pockets of rental shortages in certain areas. Thus, our budget request includes funding for section 202 new construction, Indian public housing, and two new grant programs of rental housing construction and rehabilitation. The result is a comprehensive approach which relies primarily on vouchers, but also makes use of construction and rehabilitation programs where needed.

RENTAL REHABILITATION AND DEVELOPMENT GRANTS

In fiscal year 1984, we propose to implement the rental rehabilitation and rental housing development grant programs. These are both designed to increase the supply of standard rental housing. The rental rehabilitation grant program will make grants available to State and local governments to support the moderate rehabilitation of rental housing.

Generally, this would involve rehabilitation costs of up to $10,000 per unit. The Federal grant share would represent 50 percent of the rehabilitation costs, or up to $5,000, with possible adjustments for high-cost areas. The level of rehabilitation, however, would be at the discretion of the grantee. Participating State and local governments would be responsible for selecting projects and administering the program which will emphasize providing units for large families.

A $150 million funding level annually is proposed for fiscal years 1984 and 1985 to rehabilitate approximately 30,000 rental units each year. Tenants who live in units to be rehabilitated or who move into the units may also be eligible for the housing voucher and section 8 existing programs. The interim regulations implementing the rental rehabilitation program have been published.

Our proposed rental housing development grant program will make Federal grants available to State and local governments for specific new construction and substantial rehabilitation projects. As provided in the authorizing legislation, project eligibility would take into account severe shortages of decent rental housing and a lack of affordable alternatives.

The proposed funding level for the rental housing development program is $200 million in 1984 and $115 million in 1985 for construction or substantial rehabilitation of up to 10,000 and 6,000 units, respectively. These unit estimates are subject to change since some of the key program design issues are still being worked out. Because of the leadtime required for implementation of this new construction program, the initial project completions are not anticipated until fiscal year 1986. We expect to submit the proposed regulations for the redevelopment program shortly.

HIGHLIGHTS OF BUDGET REQUEST

Mr. Chairman, I now will highlight the key figures and proposals included in our budget request. Net budget authority of $10.5 billion is requested for 1985. This includes $12.5 billion in new budget authority offset by $2 billion in rescissions under the section 236 and rent supplement programs. The $10.5 billion figure is about $3.2 billion less than the 1984 budget authority estimate of $13.7 billion. This decrease is the result primarily of lower requirements for the subsidized housing programs because of the savings made possible by initiation of the housing voucher program.

Another factor contributing to the need for lower budget authority in 1985 is that all budget authority for the rental housing development and rental rehabilitation grant programs for both 1984 and 1985 is being requested in 1984.

Net outlays are projected at $15.2 billion in 1985 based on gross disbursements of $21.8 billion offset by loan repayments, asset sales, and other revenue of $6.6 billion. The $15.2 billion estimate is $650 million less than the 1984 outlay estimate. This reduction reflects higher premium receipts and sales of acquired property under the FHA mortgage insurance programs and a substantial decrease in the GNMA tandem programs since the majority of purchasing under the now-terminated program will have occurred in 1984.

The savings will partly offset the outlay increases in our subsidized housing programs. Most other programs are expected to spend at about the same levels as in 1984.

STAFFING REQUIREMENTS

Full-time permanent employees will decline to 11,910 in 1985, a reduction of 187 from the proposed 1984 level of 12,097 and 517 from the 1983 level of 12,427.

The reduced staffing reflects improved management practices, streamlined operating procedures, and use of contractual services where appropriate.

ASSISTED HOUSING

The proposed 1985 budget authority of $6.3 billion for the Department's subsidized housing program includes funding for 87,500 incremental vouchers. We are also proposing 12,500 new construction units consisting of 10,000 units for the elderly and handicapped under section 202 and 2,500 Indian housing units. This brings our total incremental housing assistance in 1985 to 100,000 units.

PUBLIC HOUSING OPERATING SUBSIDIES

We are requesting budget authority of $1.1 billion for public housing operating subsidies and $1.55 billion for the modernization of existing public and Indian housing units. The latter figure would support approximately $761 million of capital and management improvements for these valuable housing assets. This represents a continuing effort to renovate the existing stock through our comprehensive improvement assistance program.

COMMUNITY DEVELOPMENT GRANTS

Our budget request includes $3.5 billion for the community development grant program, the same level as appropriated in 1984. For the urban development action grant program we are proposing an appropriation of $440 million, also the same level as 1984. No changes are proposed in the authorizing legislation for either of these programs. We believe both are working well and the effects of the 1983 amendments should be analyzed before further amendments are proposed.

Let me reiterate the continuing commitment of this administration to help States and local communities meet their community and economic development needs through CDBG and UDAG programs. The urban homesteading program is being expanded to include demonstrations for the homesteading of FHA-owned multifamily properties and locally owned one- to four-unit properties. These demonstrations will be funded within a total appropriation of $12 million in each of fiscal years 1984 and 1985.

FAIR HOUSING ASSISTANCE

The budget also requests $6.7 million for the fair housing assistance program, an increase of $2 million over 1984. This increase reflects our commitment to enforcement of fair housing and the prompt processing of title 8 complaints.

In 1985 we will emphasize outreach efforts to increase public awareness of the purposes of title 8 and other civil rights mandates.

RESEARCH AND TECHNOLOGY

Finally, the budget proposes $20.9 million for research. I urge the committee to consider this request favorably so we can meet the new research responsibilities mandated by the 1983 authorization.

AUTHORIZATION LEGISLATION

Mr. Chairman, none of our 1984 or 1985 budget requests require enactment of authorizing legislation. The major housing and community development initiatives of the Reagan administration involving Federal financial assistance have been enacted into law. Only appropriation action is now required.

However, two initiatives remain which have not yet been passed by Congress—enterprise zones and fair housing amendments. Although this committee does not have jurisdiction over these proposals, I take every available opportunity to urge their speedy passage. The enterprise zone legislation is needed because of its importance as an economic development tool. The fair housing amendments should be enacted to strengthen the fair housing enforcement powers of the Federal Government.

NEW ORGANIZATION—PUBLIC AND INDIAN HOUSING

Also, Mr. Chairman, the budget reflects an organizational change of the Department's housing programs. We have established, as you know, a new Assistant Secretary for Public and Indian Housing, Warren Lindquist. All other housing programs, including the mortgage insurance programs, are the responsibility of Maurice Barksdale, the new FHA Commissioner, who also is with me here today.

Mr. Chairman, this concludes a summary of my opening statement. I would be happy to respond to any questions you may have.

FISCAL YEAR 1984 RECAPTURE REESTIMATE

Senator GARN. Thank you, Mr. Secretary. Your entire statement has been placed in the record. Your fiscal year 1985 budget assumes the recapture of $2,754,713,000 under the "Assisted housing" account. This is several hundred million dollars more than estimated for fiscal year 1984. We now know the fiscal year 1984 estimate is overstated. What is your latest deobligation estimate for fiscal year 1985?

Secretary PIERCE. We are in the process of studying that, Mr. Chairman. I can't give you a figure at this moment. As soon as we get one, we will give it to you, but I am sure it will be less than $2.7 billion.

Senator GARN. Of this fiscal year 1985 amount, $2,066,700,000 is estimated to come from the cancellation of public housing production. How likely are we to realize that amount?

Secretary PIERCE. We are not very likely to realize that amount; it will be less.

Senator GARN. Another $360 million is associated with new/substantial rehab. What is the basis of that estimate, and how much have we realized so far in fiscal year 1984?

Secretary PIERCE. We have realized $290 million in fiscal year 1984, and I will ask Mr. Kliman to discuss the basis of the estimated amount of $360 million.

Mr. KLIMAN. Mr. Chairman, the estimated $360 million relates to an estimate of 3,000 units of section 8 new and substantial rehab which are simply estimated, at this point, to not meet their deadlines for construction.

ANNUAL CONTRIBUTIONS CARRYOVER INTO FISCAL YEAR 1984

Senator GARN. Before marking up our fiscal year 1984 bill, we asked the Department if there would be any fiscal year 1983 carryover. The answer was "No." You actually did realize a carryover of almost $1.5 billion. I see your estimate on fiscal year 1985 is $82,542,000. What is the basis of that estimate?

Mr. KLIMAN. The $82 million is a calculation of the balance left after taking all the available funds and applying all the statutorily mandated programs to it, along with the budget proposals. It is simply an arithmetic calculation of the amount left over.

Senator GARN. Will it be possible for you, Mr. Secretary, to provide us with an update of deobligation by next week?

Secretary PIERCE. Yes.

HOUSING NEED FOR LOWER INCOME FAMILIES

Senator GARN. The construction of new housing for low-income housing is deemed too costly. Such programs would be almost entirely replaced by demand-side subsidies—housing payment certificates—to be used in lower priced, but standard, quality housing. Against this background and the requirements to reduce Federal spending, it becomes extremely important to assess the extent of our Nation's housing needs and how they might be most economically addressed.

As a first step in this direction, last year I asked you to prepare some data on our housing needs using the model developed by the subcommittee. That model was used to determine the number of incremental housing units contained in the Senate version of the fiscal year 1984 appropriations bill and, in fact, Public Law 98–45 closely paralleled the results of the model. I believe it is important to pursue the development of such a model for several reasons.

First, it facilitates Congress' review of the various policy decisions that must be made in developing such a model. Second, it provides a more predictable funding environment for program managers and housing agencies. Finally, such a model permits us to measure our progress in meeting explicitly stated objectives. Consequently, I asked HUD to assist us in improving it. A copy of the model is before you now, and I would ask that it be put in the record at this point.

[CLERK'S NOTE: A copy of the 1984 model of rental housing needs is being retained in the subcommittee files.]

SECRETARY'S ASSESSMENT OF HOUSING NEED MODEL

The analysis reveals that there are approximately 2.8 million very low-income renters with worst-case housing problems; that is, families living in physically inadequate housing or having a rent burden of over 30 percent. Although these are large numbers, they are manageable when compared to the over 21.2 million very low-income families. This is one way of defining housing needs and identifying a target population for Federal assistance.

What is your assessment, Mr. Secretary, of this model? Do you feel it is helpful and, if not, does the Department have a better way of trying to assess housing needs.

Secretary PIERCE. I think the model is a very good one. Our research office has worked with your people on this. I think it is very good and very accurate. I notice there are 133,000 annual additions needed. That is very close to what we believe, because in that 133,000 you have housing that is supplied by the Farmers Home Administration. If we take that out, I think our 100,000 is a very good figure.

TARGETING VACANT UNITS

Senator GARN. One of the benefits of this type of analysis is that it reveals several interesting policy options. For example, the use of housing units to be available through vacancies during the year. Over 344,000 units fall into this category. What recommendations would you make in terms of targeting those units?

Secretary PIERCE. You mean the 344,000?

Senator GARN. Yes, turnover that becomes available through vacancies.

Secretary PIERCE. We try to target them, of course, to those who need housing the most. That is what we are going to try to do. That is where we will target such housing.

Senator GARN. What proportion of individuals currently entering assisted housing units would you estimate are worst case as defined by the model?

Secretary PIERCE. You say worst-case rental needs, as of 1984. The model states it is 2.8 million. I would assume that is correct, according to the model. That is the worst case rental needs as of 1984, and expressed on an annual basis, the model indicates it is 353,000. So I guess the model would mean that 1984 worst-case rental needs total is 2.8 million, and, on an annual basis, it comes to 353,000.

Senator GARN. Mr. Secretary, I have some additional specific questions about the model. Maybe the best thing to do is to ask you to respond to them in writing for the record.

Secretary PIERCE. Thank you.

[The questions and answers follow:]

HOUSING NEEDS ANALYSIS—WORST CASE

Question. What proportion of individuals currently entering assisted housing units would you estimate are worst case as defined by our model?

Answer. The Annual Housing Survey (AHS) for 1981 indicates that among unsubsidized, very low-income families approximately 50 percent have worst-case needs as defined by the Senate subcommittee model.

Question. Our model indicates that we might need to add 113,000 HUD-assisted units per year to the housing inventory in order to address the worst-case households over the next 8 years. How many units does your budget anticipate adding to the inventory during fiscal year 1985 and what are your budget assumptions for the outyears?

Answer. The HUD budget anticipates reserving 100,000 incremental units per year in the combined section 8 and public housing programs during fiscal year 1985 and the outyears.

MODERNIZATION OF VACANT PUBLIC HOUSING BUILDINGS

Senator GARN. On two previous occasions, this subcommittee initiated an effort to rehabilitate vacant, but otherwise viable, public housing buildings as a means of providing units at a cost significantly lower than new construction. Last month at our request, you completed a field survey of vacant public housing buildings. That survey indicates that there are 141 vacant buildings that are partially funded and 522 vacant buildings that are not yet funded. Would you please supply a copy of that survey for the record?

Secretary PIERCE. Yes, we will.

[The information follows:]

SURVEY OF VACANT PUBLIC HOUSING

A summary reflecting the results of the survey of vacant buildings in public housing projects follows:

	Number
PHA's with vacant buildings	92
Projects with vacant buildings	244
Units in projects with vacant buildings	58,365
Vacant buildings	1,767
Vacant units in vacant buildings	11,655
Vacant units in projects	19,290
Status of vacant buildings:	
Funded	834
Partially funded	141
Demolition/disposition pending	167
Combined funding and demolition/disposition	103
Not yet funded	522
Units to be funded	(3,297)

The national summary reflects a total of 3,297 vacant units which are in the 522 totally vacant buildings which have not received any funding. This number was reduced by 217 units from the total of 3,514 units reported earlier. These 217 units are single-family dwellings that do not require rehabilitation, but are vacant for other reasons such as poor location or normal turnover.

The Department estimates it would cost $62,577,060 in budget authority to rehabilitate the 3,297 vacant units. This estimate is based on a per-unit rehabilitation cost of $18,980 in budget authority which was the per-unit cost for vacant units funded from the fiscal year 1983 vacant unit set-aside. This estimate might be overstated since it is possible that some of the vacant units will not require rehabilitation.

It costs $180,000 of budget authority per unit for the construction of new public housing units.

VACANT UNITS AND COSTS IDENTIFIED IN MODERNIZATION SURVEY

Senator GARN. How many housing units does that represent?

Secretary PIERCE. 3,297.

Senator GARN. Based on your experience of the prior vacant building rehabilitation programs, how much would you estimate it would cost to rehab these units?

Secretary PIERCE. $62,577,060.

Senator GARN. Based on your previous experience, what are the per-unit costs relative to the cost of public housing new production?

Secretary PIERCE. $18,980 per unit for rehab and $180,000 per unit for the construction of new housing units.

PUBLIC HOUSING DEVELOPMENT PIPELINE

Senator GARN. Several months ago I asked you to conduct a field survey in order to determine the number of public housing units in the pipeline and their status. The tables you submitted show about 64,000 units and $8.6 billion in the public housing pipeline as of February 1983. By February 1984, the pipeline was reduced to 28,000 units and $4 billion. I see from the table 3,900 units were terminated because they missed the February 3 site selection deadline and about 2,000 had their site approval extended. On what basis were they given additional time to locate a site?

Secretary PIERCE. Time was extended for two fundamental reasons. One would be where a project is involved in litigation and the other where the delay is caused by HUD.

Senator GARN. When will the extension period expire for these units?

Secretary PIERCE. It varies with the circumstances, and I cannot give you an exact date. For example, we have little or no control over the litigation factor and that could cause projects to be extended for a sizeable amount of time.

Senator GARN. How many of these units would you expect to be terminated?

Secretary PIERCE. I really don't know that exactly. On a basis of historical factors, I would estimate about 10 percent.

Senator GARN. Of the approximately 26,000 units with an approved site, how many do you expect to miss the May 3 construction deadline, and how much budget authority does this represent?

Secretary PIERCE. Only a half of those 26,000 units need to meet the May 3 deadline. I would estimate approximately 10 percent of the 13,000 remaining, or 1,300 units, would miss the deadline.

SPENDING RATE FOR MODERNIZATION FUNDS

Senator GARN. Today we have provided $7.6 billion for the CIAP program. Although the objective of upgrading our public housing stock is commendable, it is the implementation of the program that will ultimately determine its success and political support.

Last month we asked you to provide us with an update of the amounts appropriated, approved, advanced, obligated, and expended to date. Let me read those numbers to you: $7.6 billion appropriated, $6.1 billion approved, $1.7 billion advanced, $1.6 billion obligated, and $0.8 billion expended. Thus, about 11 percent of the appropriated funds have been expended since fiscal year 1981. These figures certainly support my contention that this is not a jobs program, as some of my colleagues would contend.

Could you describe what steps you are taking to accelerate the distribution of the fiscal year 1984 funds?

Secretary PIERCE. We have done many things to accelerate the distribution of the fiscal year 1984 funds, but I will ask Mr. Lindquist, who has been working on that specifically, to comment.

Mr. LINDQUIST. Mr. Chairman, all but $118 million of the 1984 money have now gone to the field. We are in good shape for this year. The joint reviews have been completed for this year's money and we expect the money will actually be in the hands of the authorities by June at the latest.

We are, for the future, setting up some procedures which we think will expedite the public housing agencies' actual expenditure of the money. After they receive the approval of their final application, the PHA's in 15 days will be required to provide a schedule of the entire modernization process for each project where there is CIAP money to be spent. The schedule will be based on national norms and the authorities will be closely held to that schedule.

We are confident that we will be able to do a much better job of getting the authorities to spend their time in a timely and effective manner than we have been able to do in the past.

DEVELOPMENT OF NEED AND GOALS FOR MODERNIZATION

Senator GARN. Thank you. As you know, the Fiscal Year 1984 Appropriation Act provided $4 million for an extensive update of the Perkins and Will study and a review of our accomplishment to date. I think this study is essential for two reasons. First, we must develop some measures of need in order to limit the Federal exposure on the CIAP program. Second, we need to establish goals and objectives in order to measure the program's success and determine the appropriate levels of funding.

For the benefit of the subcommittee, could you please bring us up to date on the progress of the study?

Secretary PIERCE. Yes; we have been moving along with that study, sir, and we expect to be finished in December 1985, but I would like to have Dr. Bobo who has been working on the study to give you a more detailed picture of exactly what we have been doing.

STATUS OF MODERNIZATION STUDY

Dr. BOBO. Mr. Chairman, this is the largest single research project that is currently underway in the Department. As you know, the committee instructed us to establish an advisory committee to work with HUD and the contractor on the study. We have done that. Mr. Berger chairs that committee. The actual field work inspections will begin in September 1984. We have a sample of 1,369 projects that we will be looking at, at that time. The completion of the estimates will look like this, Mr. Chairman:

The national estimates will come in in January 1985; the regional and field estimates in June 1985; the CIAP program report, September 1985; and the final report in December 1985.

Senator GARN. Do you expect these cost estimates to be accurate within plus or minus 10 percent?

Dr. BOBO. Mr. Chairman, we do expect the estimates will be accurate to within plus or minus 10 percent.

Senator GARN. Mr. Secretary, I understand the congressional/PHA advisory group has been helpful in identifying potential problems with the approach and how the HUD data collection effort can be improved. I would appreciate it if you would prepare a brief paper for us by June 1 describing the activities of the advisory group and the progress of the study.

Secretary PIERCE. We will do that, sir.

[The information follows:]

Report of Progress of Study of Public Housing Modernization Needs and Activities of the Associated Advisory Group

In questions to the Department, the Senate Appropriations Committee asked for a brief report on the status of research on modernization in the Public Housing Program and on the activities of the informal Congressional/PHA advisory group associated with the study. The research was requested by Congress in the House of Representatives Reference Report Number 98-264 dated July 23, 1983 which provided for FY 1984 appropriations to the Department.

The research contract, entitled "Modernization Needs of the Public and Indian Housing Stock," was awarded to Abt Associates of Cambridge, Massachusetts and got underway in November 1983. The primary intent of the research is to determine the nationwide modernization needs of the public housing and Indian housing stock, including those needs related to energy conservation and accessibility to the handicapped. The researchers will send architects and engineers to about 1300 public housing projects and 40 Indian housing authorities to perform inspections using standardized techniques. Initial nationwide estimates of modernization needs will be available in February 1985, subject to refinement as additional data becomes available. Final project reports are done in December 1985. These reports will include information on the rate of physical depreciation of the stock, and reports on the special needs of troubled projects and projects in need of redesign.

Activities of Advisory Group

The advisory group has met several times to discuss the research project's design, its data collection procedures, and its progress. Meetings have been open and have been attended by representatives of public housing interest groups and other interested parties as well as by representatives from HUD.

Members of the group from Congressional staffs are: Mr. Stephen Kohashi, Chief Clerk, U. S. Senate Subcommittee on HUD and Independent Agencies (Mr. Kohashi replaced Mr. Wallace Berger); Mr. Philip Sampson, Staff Director, Housing Subcommittee of the U. S. Senate Banking Committee; Ms. Diane Dorius, Counsel to the Housing Subcommittee of the U. S. House of Representatives Committee on Banking, Finance and Urban Affairs; and Mr. Richard Malow, Chief Clerk of the HUD and Independent Agencies Subcommittee of the U. S. House of Representatives Committee on Appropriations. Public housing authorities represented on the committee range from small to very large, from the East Coast to the West Coast, and include PHAs with stock conditions ranging from very good to very poor. In sum, the advisory group members are broadly representative of a wide variety of PHA types, and many members of the group have decades of experience in dealing with public housing management problems and project modernization. Interest groups that are regularly represented at meetings include the National Association of Housing and Redevelopment Officials (NAHRO), the Counsel of Large Public Housing Authorities (CLPHA), and the PHA Director's Association (PHADA).

The advisory group has met four times since fall of 1983. The group has been beneficial in discussing many key areas of the study including the amount and standards for pretesting instruments, the systems to be evaluated in the inspection, how PHAs should make assessments of project conditions, and how to evaluate the need for capital additions to projects.

Although technical advisors from PHA membership organizations are used in many studies, and we had always planned to have such a group for this research, the advisory group for this study as requested by Congress is far more elaborate than most used. Given the size and importance of this research, it is essential that there is a general consensus among all key decision makers that the results of the research are accurate and objective. Thus, despite the relatively high cost of the group in terms of both time and resources, the group has been productive and will continue to be useful as it continues to help build an objective base for policy discussions regarding the future of the program.

Progress of the Study

To date, the project has developed a research design and techniques to be used in the architectural and engineering surveys. Inspection instruments have already undergone pretesting in 8 housing developments and have been demonstrated to work efficiently. Further pilot tests are scheduled in 9 PHAs around the country in late June to evaluate further the accuracy of the instruments and the techniques used to perform the inspections.

Progress in specific areas is noted below:

Research Design. The project research team includes architects, engineers, research design experts, and social scientists as well as support staff. They have produced a research design that includes a sampling plan, a procedure for inspections and costing of modernization needs. They are developing methods for estimating required PHA replacement reserves, and plans for an evaluation of the CIAP program.

Instrument Design. The research team has developed a set of instruments for architectural and engineering inspections for a variety of project types and conditions. The technique developed is a building systems approach in which 75 systems are inspected and evaluated whenever they are present in the sampled locations. This approach is geared to capital budgeting inspections because it can produce computer analyzed data files and because these data files can be used to develop costing information.

Pretest of Instruments. The architectural and engineering inspection instruments were pretested in 8 public housing projects in the Boston area. The projects included a variety of project sizes and conditions. The inspection instruments were found useable by the inspectors for collecting information on project conditions.

Sampling Data. The research team has sent out questionnaires to approximately 1,200 housing authorities regarding the conditions of their projects. Most PHAs have responded with their own estimate of modernization needs. This data will be used in developing the sample of projects to be inspected. The researchers will focus on those projects that have the highest modernization needs.

Future Activities

During the remainder of the summer, the research team will be fine-tuning the inspection instruments and completing the questionnaires used to interview PHA officials familiar with the projects to be inspected. The pilot test is planned to be completed by early July, and the evaluation of pilot test results will be completed by the end of August. Inspections of the sample of projects will be done starting in late September. Data file creation will be completed in March, with evaluation of inspection results done in the summer of 1985. Final reports are due in December 1985.

In summary, the results of the study will affect the expenditure of billions of dollars and the physical viability of the housing projects of the nearly 3,000 PHAs. Thus, the Department is placing a great deal of emphasis on the research and is committed to the development of an accurate estimate of the physical improvement needs of the nation's public housing stock.

CONVERSION OF SECTION 8 EXISTING TO HOUSING VOUCHERS

Senator GARN. Your fiscal year 1985 budget assumes conversion to vouchers of 160,000 section 8 units as a result of turnover. If you were to follow this conversion policy through fiscal year 1990, how many units would be under vouchers?

Secretary PIERCE. Roughly 1.3 million.

Senator GARN. How much new budget authority would we have to appropriate in fiscal year 1990 to fund the 5-year continuation of the vouchers expiring in fiscal year 1990?

Secretary PIERCE. For 1990, it would be $315,503,000.

Senator GARN. What about fiscal year 1995?

Secretary PIERCE. $365,722,000.

Senator GARN. This does not include a potential of $2 billion annually for 100,000 incremental units. It also does not include $2 billion annually to maintain the incremental units in the inventory. So we are still talking about a very large significant commitment of Federal funds.

Secretary PIERCE. Yes.

Senator GARN. For fiscal year 1985, you—I won't worry about fiscal year 1995. You may still be here.

Secretary PIERCE. No; no.

PUBLIC HOUSING RENTAL INCOME

Senator GARN. I will guarantee you I won't. For fiscal year 1985 you are requesting $1,123,500,000 for public housing operating subsidies. This is $238,700,000 less than the level appropriated in fiscal year 1984. Let's compare your current best estimate for 100 percent of the PFS in 1984 with your 1985 request. How much rental income do you expect in fiscal year 1984?

Secretary PIERCE. Mr. Lindquist.

Mr. LINDQUIST. I don't have the figure right here, sir.

Senator GARN. Will you supply that for the record?

Secretary PIERCE. Yes.

UNDERESTIMATED PHA INCOME

Senator GARN. Also I would like to know for fiscal year 1985. What impact have you estimated for underestimated PHA income?

Secretary PIERCE. $35 million.

[The information follows:]

PUBLIC AND INDIAN HOUSING RENTAL INCOME ESTIMATES

The incorrect estimation of income by PHA's has resulted from improper application of regulatory procedures or failure to use the best available information in making estimates. Section 323 of the Housing and Community Development Amendments of 1981 and sections 206 and 213 of the Housing and Urban-Rural Recovery Act of 1983 have the effect of increasing the likelihood of estimation error since they result in significantly hard-to-predict revenue changes. Given these considerations, the Department believes that the only equitable way of correcting estimate errors is to have a yearend reconciliation between estimated and actual rental and investment income. Failure to do so will penalize some PHA's for circumstances beyond their control and leave others with unintended windfalls. We have already implemented a procedure for investment income adjustments and are preparing a proposed rule relating to yearend rent revenue adjustments.

PHA's can maximize rental income by minimizing vacancies, collecting all rents due, and by serving as high an income mix as possible. Currently, there is no direct incentive to minimize vacancies, because the current PFS funding mechanism allows full operating expenses and reimburses for vacancy rent revenue losses. Most PHA's do a very good job of minimizing vacancies, but some have had continued high vacancy levels over a period of years despite high modernization funding levels. In the latter instance, the Department believes that paying for the full cost of vacant units as if they were occupied provides a perverse incentive. A proposed rule has been issued which would strengthen incentives to achieve and retain normal occupancy levels by disallowing some costs associated with unusually high vacancies. This, in effect, provides an incentive for higher occupancy levels and rental income.

The current operating subsidy mechanism assumes full rental income is collected for all occupied units. Uncollected rents owed to a PHA are not reimbursed by HUD. This is a strong incentive to achieve a high collections level.

PHA's could increase rent revenues by renting only to the highest income tenants that they are allowed to serve; however, there is no financial incentive for PHAa's to do so. The Department supports local efforts to achieve an income mix within the program, but does not believe it is appropriate to penalize PHA's which serve a lower income mix. However, this would be the net effect of any effort to provide a financial incentive for renting to higher income tenants.

PUBLIC HOUSING UTILITY EXPENSES

Senator GARN. How much do you expect will be needed for all utilities in fiscal year 1984?

Secretary PIERCE. Can we supply that for the record? We don't have the figure here.

Senator GARN. Yes, I would like that for fiscal year 1985 as well. I would doubt very much that it is likely overall utility rates will remain essentially at the fiscal year 1984 level. If we look back over the last 10 years, that simply does not happen.

[The information follows:]

PUBLIC AND INDIAN HOUSING RENTAL INCOME ESTIMATE AND UTILITY PAYMENT REQUIREMENTS

The Department estimates that public housing agency (PHA) and Indian housing authority (IHA) rental income will amount to $1,628.9 million in fiscal year 1984. It is anticipated that PHA and IHA projects will require $1,075.1 million in fiscal year 1984 and that $1,063.5 million will be needed in fiscal year 1985 for utility payments.

HOUSING FOR LARGE FAMILIES

Senator GARN. Both the House and Senate Appropriations Committees have been somewhat concerned about the tendency to use public housing construction funding for elderly and small family units and the use of modernization funds for the conversion of multibedroom units to efficiency and one-bedroom apartments. Are you concerned with this trend?

Secretary PIERCE. Yes, we are.

Senator GARN. Would you recommend placing restrictions on the use of public housing modernization or section 8 existing funds to encourage the inclusion of large family units in the inventory?

Secretary PIERCE. I would not encourage that, sir. We are concerned with the trend, and we have done a number of things to try to improve the situation for large families. We have increased the fair market rental allowable for large families and have increased the administrative fees to households in efforts to increase participation by large families.

Under legislation we propose for the new rental rehabilitation program, we are assuming grantees will plan programs in which at least 70 percent of the rehabilitated units have two bedrooms or more, and in the new housing development grant program, the selection process will favor projects that include a large portion of units for large families.

Senator GARN. Will the two or one-and-a-half or one swap of new construction for existing section 8 or moderate rehab have any effect on this situation?

Secretary PIERCE. For the majority of localities swaps make sense, and the existing units provided can be used to assist large families also. Mr. Lindquist, who has to work on this problem and is working on it, may have a few more comments.

Mr. LINDQUIST. No, sir.

Secretary PIERCE. He has no more to say.

LARGE FAMILIES ON PHA WAITING LISTS

Senator GARN. What percent of the families on PHA waiting lists are large families?

Secretary PIERCE. We cannot give you an exact number on that because we don't require the public housing agencies to specifically supply us with that information, but we do know from the Annual American Housing Survey that about 10 percent of very low income renters—that is, households eligible for housing assistance programs—are families of five or more people.

NUMBER OF VOUCHERS FOR LARGE FAMILIES

Senator GARN. What proportion of the fiscal years 1984 and 1985 vouchers are likely to be used by large families?

Secretary PIERCE. We think that it would be probably in excess of 15 percent. In fact, given the steps we have taken recently to increase participation by large families, we would expect some improvement over past rates under the free-standing voucher demonstration, perhaps as much as 20 percent. Since we anticipate that at least 70 percent of the units rehabilitated under the rental rehab program will be two-bedroom units or larger, it can be expected that something in excess of 20 percent of these vouchers will be utilized for larger families, perhaps even more.

Senator GARN. Thank you, Mr. Secretary.

Senator D'Amato.

Senator D'AMATO. Thank you, Mr. Chairman. At the outset, Mr. Secretary, let me commend you and your Department, HUD, for undertaking some rather difficult changes, some that were met with skepticism and consternation in the housing community. I think you have made the most of a difficult situation in seeing to it that we maximize those dollars that have been available.

So I just want to commend you for your leadership and commend your staff, your Assistant Secretary Lindquist, Mr. Wilson, Mr. Barksdale, and others who we have come into contact with. I say we, meaning my staff and housing agencies in New York.

RECAPTURES RESULTING FROM MAY 3 DEADLINE

Now for the bad news. The fiscal year 1985 budget assumes over $2 billion in recaptured public housing production funds, and I suspect the May 3, 1984, construction start deadline is expected to cause the recapture of a number of these dollars.

Do you have a figure on how many units you expect to be recaptured as a result of the deadline being enforced? Will there be some flexibility that will recognize unique circumstances that may have occasioned these delays so that there will be some discretion exercised in the recapture of these funds?

Secretary PIERCE. Yes, we do have flexibility. I can't give you the exact number of units that will be recaptured, but there is flexibility, and it is based primarily on situations where HUD has made a mistake or where there is litigation involved.

Senator D'AMATO. For example, if there has been litigation that may have held up a project and plans have been produced, et cetera, and the delay is beyond the control of the parties or unique circumstances have developed, then there will be that exercise of discretion, recognizing these unique circumstances?

Secretary PIERCE. Yes, we have done it in the past and will probably do more of it in the future.

Senator D'AMATO. I know you, Mr. Lindquist, Mr. Abrams, and others have demonstrated that flexibility. I am deeply appreciative. I think it should be said for the record that where there are projects that have bona fide problems beyond their control and they are ready to go and in the pipeline, that discretion can be exercised in those questions.

EFFECTIVENESS OF HOUSING VOUCHERS

The 1985 budget proposal calls for $1.36 billion for 91,000 housing vouchers. Vouchers are intended to be given to, I see, 87,000 newly assisted families, 2,500 displaced families, and 1,000 section 8 households. I am concerned inasmuch as the voucher program has been only a demonstration program to date. Is it advisable for HUD to request authority for the use of nearly 251,000 vouchers in fiscal year 1985, given that we have only used some 15,000 in 1984 on a demonstration basis. Might it not be wise for HUD to first determine the effectiveness of the program?

Secretary PIERCE. Actually, we think we have determined that already. The whole situation started with the experimental housing assistance program back in 1970. So we really have been working with the voucher program for many years. It is not exactly the same as the voucher program we have proposed, but it is basically the same.

The voucher program is based on the section 8 existing housing program, which is very similar to the voucher program, except it doesn't have as much flexibility and doesn't have a couple other things that the voucher program has, but basically they are the same. We have, I think, enough experience.

Senator D'AMATO. What I am concerned about, Mr. Secretary, particularly as it applies to New York, where the areas where we have very low vacancy rates——

Secretary PIERCE. That is why we have the other part of the program. In areas where there are rental shortages, we have a rental rehab program, and we are asking for a building program, so we hope to take care of that situation with those parts of our program.

Senator D'AMATO. Will you monitor this quite carefully as it applies to those areas where we have that low vacancy rate, particularly in New York, so that we can see to it we don't create more problems?

Secretary PIERCE. We certainly will.

HOUSING ASSISTANCE TO HOMELESS

Senator D'AMATO. I think, again, Mr. Secretary, your assurances will bring some relief to the minds of many people, and I know you have spoken to many of the city agencies, the people who are concerned with respect to that problem.

As you know, the Housing and Urban-Rural Recovery Act of 1983 authorized up to $60 million for your HUD block grants to States, local governments, and nonprofit agencies, for use in making programs available for emergency shelter for the homeless. Now that $60 million, I understand, is going to be part of the FEMA shelter program. What is the rationale for that move? Is that the best place for those moneys to be administered through?

Secretary PIERCE. I think so, because FEMA is more involved with emergency situations and finding shelter for the homeless, in a sense, is kind of an emergency situation. People lose their homes and are out on the street for some reason. We think perhaps that organization can do it better than we can because it is really part of their work.

Senator D'AMATO. In other words, their experience in reacting to emergency and crisis situations, you believe, will give them the ability to better attack that problem?

Secretary PIERCE. Yes.

SECRETARY'S DISCRETIONARY FUND

Senator D'AMATO. Mr. Secretary, I think there is inadequate funding in the Secretary's discretionary account. What is it, $68 million?

Secretary PIERCE. $68.2 million. I know it exactly.

Senator D'AMATO. 68.2; question 4 here. I was looking for this one because I saw it coming down on the plane today. It is $68.2 million. It sounds like a lot of money, but a large percentage is directed already to Indian housing, community development programs, and other important but targeted purposes, leaving little funding for a variety of programs and projects that maybe should be undertaken, that could pay great dividends in the future. I am wondering, wouldn't the Secretary really recommend to have that $68.2 million increased somewhat to give the Secretary and HUD the ability to fund those special projects. What is your response to that? Is OMB listening?

Secretary PIERCE. There is no doubt we usually have many more requests than we have money for. Of course, I think that is a matter for the Congress to consider, weigh, and decide.

Senator D'AMATO. Mr. Chairman, I have one or two other questions. I am going to submit them for the record. Let me make two observations if I might.

No. 1, possibly the chairman would view this as a request. I recognize the Secretary's reluctance maybe to come before the committee and ask for additional funding in that area. Stockman would be calling him up and asking him what he did. Is anybody from OMB here? Where are they? It's that ominous looking person. But anyway, he can't answer that, but I really—I want you to know, my counsel here is a ventriloquist.

I wonder, Mr. Chairman, if we might possibly look and examine the percentage of moneys that really are allocated to the Secretary's discretion, not subject to other commitments, and perhaps consider some adjustment in the area.

Second, I would be remiss if I didn't give special recognition, as I said—let's go off the record.

[Discussion off the record.]

Senator D'AMATO. In the area of senior citizen housing in really working to make the program more effective and providing additional funds and working to make them available, I just want to say a very special word of praise and commendation to the chairman, Senator Garn, for his outstanding leadership in this area. I am truly appreciative of your recognition of those special needs in other areas of the country do have, not just New York, in the Northeast, and many other communities. I am very appreciative. I know if my constituents understood that it is not in your best political interest they would also be very appreciative as I appreciate it, Senator Garn.

Senator GARN. That is because we live longer in Utah; we have a longer life expectancy. More old people and more babies, so I have to take care of both ends.

Senator D'AMATO. Thank you very much, Mr. Chairman. Thank you, Mr. Secretary.

Senator GARN. That really is true. We do live a lot longer in Utah. We also have the highest birth rate. My seven children are just an average family, just very average.

Senator D'AMATO. No wonder you kept asking about the large families. I can see your concern.

Secretary PIERCE. They can't take care of those kinds of families. That is extra large.

PHA INCOME UNDERESTIMATES

Senator GARN. Mr. Secretary, as you know, I expressed concern about the potential impact that might result from the implementation of a recommendation made by the HUD Inspector General. Specifically, I am referring to his January 20, 1984, internal audit on rent projections used by public housing agencies. The Inspector General recommends HUD implement requirements for PHA's for 500 or more units to reimburse HUD for excessive subsidies due to income underestimates.

I understand that in many instances the income underestimates in question were based on applying then current HUD regulations and operating procedures. Many PHA's prepared, as permitted by regulation, realistically, but conservatively, income estimates. The resulting PHA budgets were reviewed and approved by HUD staff. I further understand that in those areas where agencies received additional subsidies as a result of underestimates, the subsidies were used to support legitimate ongoing public housing agency activities approved by HUD.

On April 13, Mr. Lindquist sent me a letter indicating only those PHA's that failed to follow HUD regulations would be subject to the recapture procedure.

Could you be more specific about HUD's policy on underestimates of rental income?

Secretary PIERCE. Mr. Lindquist has been working on this problem and has discussed it with me a great deal. I would like for him to answer that.

HUD POLICY ON PHA INCOME UNDERESTIMATES

Mr. LINDQUIST. Mr. Chairman, as we said in the letter to you, the amount of money to be recovered will be only that attributable to failure to follow HUD's regulations and handbook. The recoveries will be made by reducing the ensuing years' operating subsidies. Recovery will go back for only 2 years.

In the event that the recovery would impose financial hardship on a public housing authority, the period for recovery will be extended over the number of years necessary to break it up so it will not impose a hardship in any one year.

Senator GARN. It is my understanding the public housing officials have recommended changes in the performance funding system which would address the issue of over- and under-estimates of income expenses. What recommendations have they made?

Mr. LINDQUIST. I am not aware of the recommendation that the authorities have made, but we have been considering yearend adjustments for the rental income, and we already do have, in effect, a yearend adjustment for investment income. And the experience with the yearend adjustment of investment income has been that it does provide an incentive for the authorities to handle their investments economically and to have them produce as much income as is consistent with safety, and it has been working very well. We hope to have a regulation on the rental income yearend adjustments in effect for fiscal year 1985.

Senator GARN. I hope, Mr. Lindquist, that the public housing agencies and the Department can work together and pursue some changes which will require realistic income projections, but, at the same time, create incentives for the PHA's to increase their rental income.

Could you report back to the subcommittee on what steps you intend to take to make sure that the problem does not reoccur and what incentives you might recommend to the PHA's to maximize their rental income?

Mr. LINDQUIST. Yes, sir.

JOBS CREATED—EMERGENCY JOBS ACT

Senator GARN. On March 24, 1983, Congress enacted the Emergency Jobs Appropriation Act. This act appropriated $4.6 billion to provide for programs that were soon to create immediate jobs. Of the total $4.6 billion, $1 billion was appropriated for community development grants. At the time that bill was being considered in the Senate, I expressed concern that putting money in the CD program was a very ineffective strategy for creating jobs.

How much of the $1 billion has been expended to date?

Secretary PIERCE. As of March 31, 1984, $235.7 million, or 24 percent, of the total jobs bill funds obligated have been expended.

Senator GARN. How does that rate of expenditure compare to the normal CDBG expenditure rate?

Secretary PIERCE. Jobs bill rate of expenditures is much faster than the normal CDBG rate.

Senator GARN. But still, you would have to agree that all the talk on the floor about this immediate job creation effort, even though it is faster than the normal process, the answer you have just given me, after a year, it certainly was not an immediate job creation activity.

Secretary PIERCE. That is true.

Senator GARN. As a matter of fact, I made a comment on the floor at the time that obviously the recession was over because we were passing a jobs bill. What has been the number and cost of jobs created with CDBG jobs bill funds?

Secretary PIERCE. Mr. Stokvis, are you here?

Mr. STOKVIS. Mr. Chairman, first of all, in the 1985 consolidated report to Congress for community development programs, we indicated, as of September 30, 34,000 jobs had been created by the jobs bill, and an additional 10,000 private-sector jobs had also been projected by grantees. If extrapolated out, we estimate that 171,000 jobs may be created. However, the cost per job is impossible to determine at this time because we have insufficient data and, in addition, many cities have not used the jobs bill money to create jobs. It is fair to say, however, that the cost per job is sufficiently higher than the $7,500 cost per job of the UDAG program.

PUBLIC SERVICE JOBS UNDER EMERGENCY JOBS ACT

Senator GARN. The bill also permitted up to 50 percent of the CD funds to be used for public service jobs. What percentage of CDBG jobs bill funds have been used for public service-type jobs?

Secretary PIERCE. 21.4 percent has been used for public service-type jobs, or $214 million of the $1 billion allocated under the jobs program.

Senator GARN. What percentage of the public service jobs will be filled by those unemployed for at least 15 out of the 26 weeks exceeding the act's passage?

Secretary PIERCE. All grantees had to certify that they would do this to the extent practicable. They would use their funds to maximize immediate creation of new employment for those unemployed for the period covering at least 15 out of 26 weeks.

We accept the grantee certification rather than undertake extensive front-end interviews, so we do not have the precise information on that.

TARGETING FUNDS TO HIGH UNEMPLOYMENT AREAS

Senator GARN. To what extent are grantees targeting funds to areas where unemployment is the highest or has been a problem for the longest period of time?

Secretary PIERCE. We do not have any specific data on that. However, because of the special formula used in the allocation of jobs bill funds, areas having the highest unemployment would have to receive more of the funds, and our monitoring efforts will enable us to find out more about this in the future.

Senator GARN. Mr. Secretary, once again, what always takes place in these emergency jobs program is proven to be true once again, essentially a failure—about $75,000 cost per job. We would be better off just to give people money. I don't understand Congress. We do this over and over again. Some of us get up on the floor and argue against it on past experience, and yet we still pass them. It is a terribly expensive way, in my opinion, to create temporary jobs.

Nothing has changed since I was mayor. We used to do the same thing. We had short-term, temporary jobs that never amounted to anything.

URBAN DEVELOPMENT ACTION GRANTS

For fiscal year 1985, you are again requesting $440 million for UDAG. Based on prior experience, the projects funded during fiscal year 1985 could leverage $3.4 billion in private investment; over 70,000 jobs could be created; and local governments could receive estimated tax revenue increases of about $70 million. What was your request to OMB for the UDAG program?

Secretary PIERCE. Our request was for $440 million for fiscal year 1985.

Senator GARN. Good heavens, you mean OMB didn't turn it down?

Secretary PIERCE. No.

Senator GARN. You should have asked for more then, I guess.

TECHNICAL ASSISTANCE FOR UDAG PROGRAM

Senator GARN. The Senate included $2 million in the Secretary's discretionary fund to provide assistance to small communities in connection with the UDAG program. Congress' agreement reduced the amount added for this purpose to $1 million. What has the Department done to date to initiate such a technical assistance program?

Secretary PIERCE. We have employed four technical assistance organizations to help us with that program, and, in addition to those four contracts, we have encouraged and participated in State-sponsored conferences. Recently we sent out mail to all eligible small cities telling them about the program and what they can do to participate in it and identifying an area office contact person to answer any questions regarding the program that those cities might have.

Mr. Stokvis is here and works in much more detail on this program. Maybe he would like to say a few words.

Mr. STOKVIS. Mr. Chairman, in the period from 1981 to 1984, the dollar amount is $7 million of contracts related to the UDAG program, the bulk of that affecting small communities.

I think the key thing to note in response to your question is how the increase of applications from small cities has resulted because of HUD's outreach program. In 1982 we had, as you may recall, a surplus of $232 million of unobligated small cities funds. That year we funded $73 million of small cities UDAG's. The following year, in 1983, we increased to $170 million.

With the round just completed by the Secretary yesterday, we have already announced close to $200 million in small cities UDAG's. That is far in excess of the 25 percent, which would be $110 million in small cities.

As a result of our providing technical assistance, we have greatly increased the number and quality of the UDAG's.

Senator GARN. Mr. Secretary, could you supply the subcommittee a quarterly list of the small communities receiving the assistance as a result of the add-on?

Secretary PIERCE. Yes, we will.

HOUSING COUNSELING ASSISTANCE

Senator GARN. During fiscal years 1983 and 1984, the Congress provided $3.5 million for housing counseling assistance, even though no funds were requested. Our fiscal year 1984 conference report contains the following language:

> The conferees note that a recent HUD review of housing counseling cast some doubt on the effectiveness of the program. Therefore, the conferees direct that the Department undertake a study to determine the most effective counseling procedures and training requirements for counselors. A report should be submitted to the Committees on Appropriations no later than April 2, 1984.

I insisted on this language because it is evident that the majority of the Members are interested in continuing the program. The least we can do is make sure the money is spent as effectively as possible.

I know that you have asked for an extension of time to complete the study. However, it is now 44 weeks since the conference report was agreed to. It seems this would be sufficient time to conduct the study.

What individual has been assigned responsibility of conducting this study, and will it be completed in August?

Secretary PIERCE. We expect it to be completed by August 31, 1984. It has been assigned to our policy development and research.

Senator GARN. Do you agree 44 weeks should have been sufficient time to complete it?

Secretary PIERCE. It is a long time, but it is a difficult study.

Senator GARN. Have you developed a study plan or formal study description as of yet, and, if so, can you submit it for the record?

Secretary PIERCE. Yes, we will submit it for the record.

[The information follows:]

HOUSING COUNSELING STUDY DESCRIPTION

The Committee on Appropriations in Senate Report 98-152 to H.R. 3133 directed that "the Department undertake a study to determine the most effective counseling procedures and training requirements for counselors."

Under the housing counseling program (HCP), the Department of Housing and Urban Development funds and certifies public and private agencies to provide counseling to current and eligible families of the Department's programs. Agencies provide advice with respect to property maintenance, financial management, and any other matters as may be appropriate to assist families in improving their housing conditions and in meeting the responsibilities of tenancy or homeownership.

The Department will prepare case studies of up to nine counseling agencies located at a variety of sites around the country. Agencies that show active and potentially successful counseling services will be selected from HUD records. These agencies will be contacted to collect information on their procedures and on the training requirements that are used in performing various counseling services. The information collected will include such items as the types of counseling sessions used (individual and group) for each type of counseling (prerental, prepurchase, default, etc.), the advice offered at these sessions, and agency followup after initial counseling. To the extent possible, actual counseling sessions will be observed. Additionally, information will be collected on required training for counselors. Although such information does not identify the most effective counseling services, it will provide us with counseling procedures and training requirements that seem adequate to these agencies.

We will also review various counseling manuals which the Department has prepared. In addition, we will review manuals such as the "Comprehensive Housing Counseling Training Program—Training/Preference Manual" prepared by the National Federation of Housing Counselors, Inc. And, finally, we will review materials on the National Federation of Housing Counselors' program of certifying housing counselors. Information obtained from these various sources will be used as the basis for extracting reasonable counseling procedures and counselor training requirements given the characteristics of particular types of counseling services provided.

CHAIRMAN'S CLOSING REMARKS

Senator GARN. Let me just say it is difficult to argue for full funding of your policy development and research program unless we see some results in the program.

Before closing, Mr. Secretary, I would like to thank Mr. Kliman, Mr. Van Lowe, and Mr. Stimpson for the very professional assistance they provided the subcommittee since our hearing last year. It has been very helpful to the subcommittee and the subcommittee staff.

SUBMITTED QUESTIONS

I do have 63 pages of additional questions for your response in writing. That is the bad news. The good news is I am not going to keep you here to ask them orally.

[The following questions were not asked at the hearing but were submitted to the Department for response for the record:]

Questions Submitted by Senator Garn

HOUSING AND URBAN-RURAL RECOVERY ACT 1983 ACTIVITIES FOR WHICH BUDGET REQUESTS ARE NOT PROPOSED

The Housing and Urban-Rural Recovery Act of 1983 authorized several programs and/or activities for the Department for which the 1985 Budget does not propose any appropriations.

Question: Why is the Department not seeking funding for the Neighborhood Development Demonstration?

Answer: The HUD appropriation Act for 1984 (P.L. 98-45) included $2 million which report language designated for a Neighborhood Development Demonstration to be funded through the Community Development Block Grant (CDBG) Secretary's Discretionary Fund. Subsequently, the 1984 authorization Act (P.L. 93-181) was passed, which established authority, under Section 123 of that Act, for a separate program for this purpose. That Act, however, did not provide for the transfer of funds from the 1984 CDBG appropriation for use under the new Section 123 authorization for the demonstration.

The House has included language in the pending 1984 supplemental appropriation which would allow the $2 million from the 1984 CDBG appropriation to be used under Section 123. The Senate is expected to follow suit. Assuming all this happens, no additional funding to implement the program would be required.

Question: The Emergency Shelter Program?

Answer: The Department is not requesting an appropriation to fund the Emergency Shelter program (Section 216) for the following reasons:

a. The program would take too long to implement and would only add layers of bureaucracy and red tape to a situation which requires immediate action.

b. Local authorities and private charities are more attuned to local needs and are in a better position to respond quickly and effectively to local life threatening situations.

c. The problems of the homeless rarely relate to the lack of available shelter. Lack of income, health problems and other sociological factors weigh more heavily in the problem of homeless individuals. The Emergency Shelter proposal addresses none of these underlying causes.

d. CDBG grantees have been notified that the acquisition and/or rehabilitation of real property for use as a shelter for the homeless is an eligible use of CDBG funds. Since the start of 1983, over $30 million in CDBG funds have been spent on assistance to homeless.

e. HUD will expedite approval of any change in program year start dates to make CDBG funds available quickly for use in assistance to homeless.

f. HUD has made available to mayors or locally appointed organizations for a $1 per year lease any HUD-held single family property for use by the homeless.

g. FEMA has provided $140 million to aid State and private sector efforts.

h. GSA is providing surplus property and equipment.

i. DOD is working with 120 food banks to use food returned by military commissaries.

Question: The HHS Demonstration Project?

Answer: The Department believes that this demonstration is more properly funded and administered through HHS rather than through HUD. Additionally, the demonstration appears to be duplicative, in several areas, of HUD efforts to assist lower income persons and, thus, this demonstration would result in unnecessary expenditure of federal resources.

Question: The Homeownership Assistance program (Section 235)?

Answer: It had been determined that in a tight budget, scarce resources should be devoted to providing rental assistance to those most in need of Federal subsidy (very low-income-families) rather than be used to subsidize homeownership. This subsidy assistance to homeowners is an inefficient and inequitable use of scarce Federal resources.

Also, the Department's subsidized housing strategy for fiscal year 1985 emphasizes subsidies for existing housing. The Section 235 program is primarily a new construction program (with a few substantially rehabilitated units).

In addition, the implementation of this restructured program could have an impact on Federal outlays as early as 1984 and for 10 years or more thereafter. We could not implement the program and restrict Federal outlays as we must do.

CHILD CARE DEMONSTRATION

Question: The House Committee report requested an evaluation of the Child Care Demonstration. What do you plan to do?

Answer: The Department is preparing a Notice to all PHAs and CDBG agencies to inform them of the child care provisions of Section 222 of the Housing and Urban-Rural Recovery Act of 1983. The Notice will inform CDBG communities and PHAs that the PHAs may make space available in their projects for child care services where the community is willing to use CDBG funds, either alone or in conjunction with other funds, for (1) minor renovations to make the facilities suitable for child care and (2) support of child care services in such facilities. The Notice also asks for data on existing child care facilities or plans to establish such a program, to supplement the information that the Department has already collected about the provision of child care at large PHAs.

Research funds have been set aside for the required evaluation of existing child care facilities (estimated cost of $200,000 over a two-year period). We are now preparing the research plan for this project, and expect to start the evaluation July 1, 1984.

PRESIDENT'S PRIVATE SECTOR SURVEY ON COST CONTROL
(Grace Commission Task Force Report on HUD)

Question: The Grace Commission Task Force on HUD estimated that its recommendations would result in over $2.5 billion in cost savings and over $1.2 million in accelerated cash receipts and additional revenues. Which of the recommendations do you agree with and what are you doing to implement them?

Answer: The Commission task force identified about 50 recommendations under ten major headings in its report on HUD. Within those 50 there were many more detailed recommendations. On the whole, we have agreed with the Commission and already have done what they recommended or are proceeding to do so now. We have differed with the Commission on some specific details, and on some of their estimated savings.

Some of the things the task force recommended we were already doing or we had already proposed for the 1984 Budget, so it is difficult to estimate what proportion of Departmental savings we can attribute to the Commission's recommendations. The savings we estimate for implementing the first three recommendations in the Report--for improving our financial management system, reviewing and revising organization and administration, and improving debt collection--should reach $295 million over three years.

In overall staffing savings, we have exceeded the Commission's recommendations for 1985 by over 100 positions.

OMB Request

Please submit a table showing your FY 85 request to OMB using the same format and categories as contained on Page H-12 of your Budget Summary.

Annual Contributions for Assisted Housing
FY 1985 GROSS RESERVATIONS

	UNITS	UNIT COST	CONTRACT AUTHORITY	TERM	BUDGET AUTHORITY
AUTHORITY AVAILABLE					
Recaptures	NA	NA	$74,000,000 a/	NA	$2,213,000,000 a/
Permanent authority	NA	NA	22,300,000	NA	22,300,000
New authority	NA	NA	744,777,600	NA	8,024,422,000
Total Available	NA	NA	841,077,600	NA	10,259,722,000
USE OF AUTHORITY					
Public Housing					
Amendments	NA	NA	10,000,000	NA	300,000,000
Lease Adjustments	NA	NA	20,800,000	1	20,800,000
Interest Rate Adj.	NA	NA	14,400,000	NA	500,000,000
Modernization	NA	NA	109,000,000 a/	20	2,180,000,000 a/
Total, Public Hsg	...	NA	154,200,000	NA	3,000,800,000
Section 8					
Section 202	14,000 b/	6,800	95,200,000	20	1,904,000,000
Housing Vouchers:					
Incremental	116,000	2,312	268,192,000	5	1,340,960,000
Turnover conversions	(160,000)	2,312	(369,920,000)	2	(739,840,000)
Opt-outs	1,000	2,371	2,371,000	5	11,855,000
Public Housing Demolition	1,500	2,371	3,556,500	5	17,782,500
Prop. Disposition	3,800	2,371	9,009,800	5	45,049,000
PHA Fees	NA	362	44,394,900	5	221,974,500
Subtotal	122,300	NA	327,524,200	5	1,637,621,000
Loan Management:					
Default prevention	6,000	3,250	19,500,000	NA	322,500,000
Prop. preservation	9,000	3,250	29,250,000	NA	483,750,000
Subtotal	15,000	NA	48,750,000	NA	806,250,000
Property Disposition	5,700	5,300	30,210,000	15	453,150,000
Conversions:					
Section 23	5,000	2,850	14,250,000	15	213,750,000
Rent Supplement/RAP	24,101	3,400	81,943,400	15	1,229,151,000
Subtotal	29,101	NA	96,193,400	NA	1,442,901,000
Amendments:					
Section 202	NA	NA	5,000,000	20	100,000,000
Contract Adjustments:					
Existing	NA	NA	25,000,000	3	75,000,000
Mod-Rehab	NA	NA	4,000,000	10	40,000,000
Loan Management	NA	NA	5,000,000	10	50,000,000
New/Rehab	NA	NA	50,000,000	15	750,000,000
Subtotal, Amendments	NA	NA	89,000,000	NA	1,015,000,000
Total, Section 8	186,101	NA	686,877,600	NA	7,258,922,000
Total PH & Sec 8	186,101	NA	841,077,600	NA	10,259,722,000

a/ Under the proposed FY 1985 Budget, PHAs would be permitted to transfer excess development and prior year modernization authority for use in carrying out priority CIAP activity during FY 1984-85. The reuse of additional recaptures would be dollar-for-dollar and would not count as a recapture or reuse of recaptured authority.

b/ Up to 350 units of the Section 202 set-aside may be used to fund the purchase of existing homes for the non-elderly handicapped.

c/ No data are available showing the distribution between debt service costs and operating expenses for existing housing subsidies. In some cases (e.g., Moderate Rehabilitation and Property Disposition units), a significant portion of the subsidy payment would to cover the cost of financing repairs.

Senator Garn—Continued

HOUSING VOUCHERS

Your proposed FY 1985 Budget provides for $1.63 billion to provide 91,000 units of Housing Vouchers. Vouchers would be given to 87,500 new assisted families, 2,500 displaced families; and 1,000 Section 8 households where landlords opted out of the Section 8 program. In addition, vouchers would be substituted for an estimated 160,000 Section 8 certificates as new tenants come into the program under existing Section 8 contracts.

Question: Have you identified areas of the country where a tight rental housing supply may exclude participation among the eligible population?

Answer: The Department has not established or specifically identified a list of areas where tight rental conditions would preclude the use of vouchers.

Question: What specific steps will the Department take to address this problem?

Answer: The Rental Rehabilitation Grant program and the Rental Housing Development Grant program are expected to be utilized to increase the supply of modestly priced housing units in those areas where pockets of housing shortage may exist. Housing shortage is one of the principal eligibility criteria used in determing the list of eligible cities under the program and in the final selection process.

Question: What is the Department's most recent estimate of the long-term costs of the voucher program, compared to those of the Section 8 program and/or new subsidized construction?

Answer: Based on FY 1985 Budget estimates of the per unit costs for Housing Vouchers, Section 8 Existing units and Section 8 New Construction and Substantial Rehabilitation (in conjunction with the Section 202 program), the following table offers a comparative budget authority analysis for a program level of 91,000 units:

Estimated Budget Authority Requirement
91,000 Unit Program

	Units	1985 Per Unit Cost Estimate	Term	Estimated Budget Authority
Housing Voucher	91,000	$3,582 a/	5	$1,629,810,000
Section 8 Existing ...	91,000	4,605	15	6,285,825,000
New/Substantial Rehabilitation	91,000	6,880	20	12,521,600,000

a/ Includes PHA fees at $287 per unit.

The previous table indicates the budget authority or the total obligation the Department may incur for a comparable number of units under the various Section 8 program components and the Housing Voucher program. It should be noted that the new construction/substantial rehabilitation per unit cost estimate reflects Section 8 reservation of authority in conjunction with the Section 202 program, a per unit cost which has traditionally been, on average, less than other new/substantial rehabilitation activity. Significant differences in budget authority requirements result from varying contract terms and per unit costs.

The table below indicates the budget authority that is estimated to be required during the period 1990-2000 to maintain the 4.5 million units level of subsidized housing which the 1985 Budget assumes will be achieved by the end of FY 1989. The table assumes no new reservation activity after 1990. Budget authority requirements reflect amounts needed to refund Vouchers originally reserved beginning in 1984, coming under payment beginning in 1985, and expiring commencing in 1990. All other Section 8 units are assumed to rollover into 15 year project based Section 8 units as their assistance contract expire during the period 1990-2000. Finally, Replacement Vouchers are utilized during the period 1990-2000 to maintain the 4.5 million unit level which would otherwise be reduced by normal drop-out, demolition and/or other reductions to the subsidized housing inventory.

Costs of Maintaining 4.5 Million Level of Subsidized Units
FY 1990 - FY 2000
(Dollars in Thousands)

Year	Refunding of Vouchers		Refunding of All Other Sec. 8		Replacement Vouchers		Total	
	Units	Budget Authority	Units	Budget Authority	Units	Budget Authority	Units	Budget Authority
1990	15,500	$315,503	NA	NA	22,000	$447,810	37,500	$763,313
1991	341,000	7,149,065	89,927	$5,724,753	22,000	461,230	452,927	13,335,048
1992	643,450	13,892,085	32,610	2,138,075	22,000	474,980	698,060	16,505,140
1993	93,000	2,068,320	20,218	1,365,322	22,000	489,280	135,218	3,922,922
1994	93,500	2,141,618	16,674	1,237,766	22,000	503,910	132,174	3,883,294
1995	15,500	365,722	7,808	778,434	44,000	1,038,180	67,308	2,182,336
1996	341,000	8,286,300	8,475	896,654	44,000	1,069,200	393,475	10,252,154
1997	643,450	16,108,771	65,039	5,610,898	44,000	1,101,540	752,489	22,821,209
1998	93,000	2,397,540	124,080	11,034,234	44,000	1,134,320	261,080	14,566,094
1999	93,500	2,482,893	156,808	15,686,750	44,000	1,168,420	294,308	19,338,063
2000	15,500	423,925	155,847	16,753,796	66,000	1,805,100	237,347	18,982,821

Question: As you know, the Congress established the Voucher program as a demonstration. In fact, Section 207 of the 1983 Housing Act is entitled "Voucher Demonstration." Based on this understanding, why is the Department requesting the use of 251,000 vouchers in FY 1985 versus the 15,000 provided in FY 1984?

Answer: The 15,000 vouchers estimated to be reserved in FY 1984 reflect additional or incremental units to the assisted housing inventory. Of the 251,000 vouchers estimated in FY 1985 only 87,500 are incremental vouchers, the remainder would be used to replace Section 8 Existing Certificates (160,000 units), to replace those Section 8 New and Substantial Rehabilitation projects whose owners have chosen not to renew their contracts (1,000 units) and for tenants affected by demolitions of Public Housing projects (2,500 units). In addition, the Department gained considerable knowledge and experience from the Experimental Housing Allowance program on which to base the Voucher program. By implementing the Voucher program on a full-scale basis in FY 1985 immediate cost savings would be realized and a more administratively efficient program would be "on-line."

Question: What legal basis does the Department have to substitute HUD Housing Vouchers for Section 8 certificates?

Answer: Budget authority previously reserved for Section 8 Existing Housing may be used to fund housing vouchers to the extent allowed by the authorization.

Question: What legal basis does the Department have to use budget authority previously reserved under the Section 8 existing program to fund Housing Vouchers?

Answer: The terms of outstanding annual contributions contracts for Section 8 are consistent with requirements of the Section 8(o) voucher program, and do not contain any language that would inhibit a conversion from certificates and vouchers. However, the voucher authority provided under Section 8(o) is limited to a finite demonstration program which, at present, is limited by Section 5(c)(7) of the United States Housing Act of 1937, as added by Section 201(b) of the Housing and Urban-Rural Recovery Act of 1983. In the absence of modification of the existing authorization language or specific authorization in the appropriation act, the Department will not be authorized to utilize previously reserved budget authority to fund vouchers having the terms authorized by Section 8(o).

Question: What specific evaluation program have you designed to study the effectiveness of the voucher program in providing adequate housing in various rental markets for various categories of renters?

Answer: PD&R will soon release a Request for Proposal to evaluate the Voucher demonstration in as many as 20 sites across the country. The research will make direct comparisons between outcomes in the Section 8 Existing Program and the Voucher program.

Question: How much money have you included in your FY 85 Budget for this evaluation and when will the results be available?

Answer: Initial results on the first use of Vouchers will be available shortly after the first year's experience with the new program. Additional reports will become available annually over the next three years. Determinations regarding the amounts of money needed for this evaluation will be made as part of the competitive procurement process.

Question: Could you please provide a copy of the study design for the record?

Answer: We are still in the process of developing the study design. A copy of the RFP will be provided to the Committee when it is ready to be released.

Question: What steps are being taken to assure that PHAs properly inspect each unit for housing quality?

Answer: The rules for housing inspection will be the same as under the Section 8 Existing Housing program.

Question: How do the housing quality standards differ from those under the Section 8 program?

Answer: Housing quality standards will not differ from those under the Section 8 Existing program.

Question: What steps are being taken to assure that PHAs properly monitor tenant eligiblity and verify their income?

Answer: The procedures for monitoring tenant eligibility and verifying tenant income for the Section 8 Existing Housing Program will apply for the Housing Voucher Program. The PHA must initially determine the tenant's eligibility and verify their income and redetermine the same during the annual reexamination of the family. The procedures used by a PHA to satisfy these requirements must be in its HUD-approved Administrative Plan. HUD reviews these procedures during its biennial management review of the PHA.

Question: For FY 1985, you are requesting $130,585,000 for PHA voucher fees. How does this relate to the fees paid under the Section 8 program per unit inspected?

Answer: The inspection and reinspection of units to ensure housing quality will continue under the Housing Voucher program. PHAs will be provided intake and ongoing fees for these functions.

The attached comparison chart shows the administrative fee system for the Section 8 Existing Housing Program as it is now, as it will be when it is revised, and how it will operate under the Housing Voucher Program. The fees for administering the Housing Voucher Program are lower than they are for the revised Existing Housing Program since PHAs will not be negotiating rents with landlords, requesting and controlling rent exceptions, or inspecting vacated units.

Senator Garn—Continued

Section 8 Existing Housing Fee Structure

	Existing Section 8 (Current)	Existing Section 8 (Proposed)	Housing Vouchers (Proposed)
Ongoing Expenses ...	Administrative fee based on 8.50% of 2BR FMR	Ongoing administrative fee based on 6% of 2BR FMR plus a 1% case-by-case travel add-on	Ongoing administrative fee based on 4.5% of 2BR FMR plus a 1% case-by-case travel add-on
One-time Expenses ..	Preliminary fee with a $275 ceiling - involves only newly authorized units-must be cost justified	Intake fee with a $270 ceiling - involves all new intakes - must be cost justified	Intake fee with a $180 ceiling - involves all new intakes-must be cost justified
Hard-to-House	N/A	$50 ceiling per successful case in areas having greater difficulty than national average Defined as single head of household needing 3 or more Bedrooms	$50 ceiling per successful case in areas having greater difficulty than national average Defined as single head of household needing 3 or more Bedrooms
Five Year Average Cost (Annual)	N/A	$376/year	Five year average (annual basis): $275

VOUCHER ELIGIBILITY

Question: How many people in this country technically qualify to receive subsidy assistance under the terms of the legislation establishing the voucher program?

Answer: Special tabulations of the 1981 American Housing Survey indicate that there were approximately 12 millions income eligible renters in the United States at that time. It is important to recognize that not all HUD programs use the same income eligibility standards. The above estimate is for "very low income" renters, who have incomes that are below 50 percent of the local area median family income. Most HUD housing assistance programs are targeted to serve such renters.

Within the 12 million very low income renters in 1981 were 8.7 million very low income "families", which in HUD Programs means families and elderly individuals. The remaining 3.3 million non-families, while below the income threshold, are generally not eligible to receive assistance under HUD subsidy programs. About two-thirds of these non-families are one-person, non-elderly renter households.

Finally, of the 3.2 million Federal rental subsidy units that were available in 1981 (under both HUD and the Farmers Home Administration Programs) an estimated 2.5 million units were occupied by very low income families as defined above. Deducting these 2.5 million from the 8.7 million very low income renter families leaves an estimated 6.2 million income eligible renter families that were not served as of 1981.

Question: What portion of the need do you meet with your proposals?

Answer: Approximately 24 percent of all very low income renters are already served under HUD programs. In addition, the Administration proposes to assist additional families through 100,000 incremental units each year.

Question: What proportion of eligible large families will be served relative to the overall eligible population?

Answer: Available data indicate that approximately 25 percent of the eligible large families are already served under HUD programs. Due to the emphasis on assisting families in Section 17 and in the Voucher Program, it is anticipated that at least 20 percent of additional assistance will go to large families.

Question: What proportion of eligible elderly households will be served relative to the overall eligible population?

Answer: Approximately 41 percent of eligible elderly renters are already served under HUD programs. Compared to the program mix under Section 8, a slightly lower percentage of additional assistance will go to elderly households as a result of the current emphasis on families and large families. However, there will still be assistance available to the elderly through the voucher, Rental Rehab and Development Grant Programs as well as through the Section 202 program for elderly and handicapped individuals.

Senator Garn--Continued

Question: How will the certificate program work in rural areas?

Answer: Both the certificate and voucher programs rely on the private-market stock of rental housing and on PHAs capable of administering the programs. The Department expects that the operation of the voucher program in rural areas will be as effective as in urban areas. Overall, experience from the Experimental Housing Allowance Program and research on the Section 8 Existing Housing Program suggests that vouchers and certificates can work adequately and equitably in rural areas. There are many smaller PHAs and State agencies that have successfully run the Section 8 Existing Housing Program in rural and non-metropolitan areas, and we expect this trend to continue.

HOUSING STARTS

Question: We have had an unprecedented upswing in the single family housing market. In many areas across this nation, however, there is a real shortage of rental housing. To what extent has there been a corresponding increase in the number of multifamily housing starts?

Answer: Relatively speaking the increase in multifamily housing starts has been greater than the single family increase. Single family starts of 1,067,600 units in 1983 were up 61 percent from the 1982 low of 662,600 units.

Multifamily starts of 522,000 units in 1983 were up 63 percent from the 1982 level of 319,600 units, and up 81 percent from the 1981 low of 287,000 units.

RENTAL STOCK

Today's rental housing market is typified by older housing units located in urban areas. Rental housing is the source of shelter for 27.5 million families--34% of all families--and the only source for many low- and moderate-income households.

Question: What is the universe of multifamily projects that currently serve and/or are designed to serve lower income tenants?

Answer: Although there are state and locally aided projects that currently serve and/or are designed to serve lower income tenants, the Department only has systematic and complete data on Federally-aided projects.

Question: Of this universe, what proportion are Federally subsidized?

Answer: As of year-end Fiscal Year 1984, it is anticipated that there will be 3.9 million Federally subsidized rental units available for occupancy by lower income tenants.

Question: What percent of these are subsidized through HUD programs?

Answer: Approximately 94 percent of these are subsidized through HUD programs and 6 percent through FmHA programs.

Question: What criteria does HUD use to determine whether the existing national Rental Housing stock is sufficient to meet the needs of low- and moderate-income persons?

Answer: HUD does not have a set of formal national criteria to determine whether the national rental stock is sufficient to meet the needs of low- and moderate-income persons. However, the HUD report entitled Rental Housing--Condition and Outlook (November 1981) discusses many such criteria, relating them to market conditions in 1980. Also, a recent HUD report to Congress entitled Estimates U.S. Housing Needs to 1990 includes discussion of the projected need for rental housing.

Question: Has HUD identified cities or locations where there is a shortage of rental housing and what actions have been taken to protect the existing housing stock in these locations?

Answer: The Rental Development Grant program is designed to address problems of rental housing shortages. A list of eligible cities has been developed utilizing a number of eligibility measures related to rental housing shortages. The eligibility factors relating to poverty, inadequate housing, vacancies and overcrowding are the mechanisms used to identify cities where there is a severe shortage of rental housing. Under the program, an eligible area is defined as a city, urban county, or other unit of general local government with a population of 2,500 or more persons determined to be experiencing a severe shortage of decent rental housing opportunities for families and individuals without other reasonable and affordable housing alternatives in the private market.

In addition, the Rental Rehabilitation program allocation formula to cities of 50,000 population or more, urban counties and states, contains factors relating to rental housing shortage including the degree of rental housing overcrowding and the extent of physically inadequate housing.

Both programs ensure the protection and maintenance of the existing stock, the Rental Rehabilitation Grants program through moderate rehabilitation of existing units and the Rental Development Grants program through its substantial rehabilitation component.

Question: Is there sufficient flexibility built into HUD's programs to see that these areas are given priority consideration?

Answer: The eligibility criteria under the Rental Development Grant program and the allocation formula factor ensure that areas experiencing rental housing shortages are considered. Further, the two programs also provide sufficient flexibility to State and local governments to design their own development and rehabilitation programs.

FY 1984 RECAPTURES

In your FY 1984 Budget submission, you estimated that recaptures during FY 84 would be $4.346 billion. In our FY 84 Appropriations Bill we assumed only $2.5 billion.

The amount of recapture is particularly important during FY 84 because the Appropriations Bill specifies that the first $1.9 billion of recaptures shall be devoted to Section 202.

Question: What is the current level of recaptures in FY 84?

Answer: As of April 30, 1984, $846 million in budget authority under the Section 8 and Public Housing programs had been recaptured.

Question: What are your projections for the remainder of FY 84 and what are the expected sources of those recaptures?

Answer: We are currently projecting a total of $1.7 billion for FY 1984. An estimated $600 million is anticipated to be recaptured from the Section 8 program and $1,100 million from the Public Housing program. We are reviewing our progress on a continual basis.

I understand that you expect to submit a reprogramming request in anticipation of not achieving the $2.5 billion recapture rate.

Question: What can you tell us about that reprogramming at this time, and when will the reprogramming be officially transmitted?

Answer: The reprogramming letter is currently being developed and is expected to be transmitted to the Congress in June.

INELIGIBLE HOUSEHOLDS

Last year, I noted that the December 1982 MIS report indicates that there has been no reduction in the number of Section 8 projects which are exceeding the limitations on ineligible households occupying Section 8 units.

Question: What actions has HUD taken to make these units available to eligible households?

Answer: The MIS reports referred to cannot be used to monitor owners' compliance with HUD's limitations on admission of ineligible (over-income) families. Since MIS looks only at a family's current income status, MIS' count of over-income tenants includes both tenants who were over-income at the time of admission and tenants who were income-eligible at the time of initial occupancy and later experienced increases in income. Our limitations on admission apply only to the first category of tenant's - i.e., tenants who are over-income at the time of admission. Tenants are not required to move out of Section 8 units if their incomes increase to amounts in excess of the HUD-approved income limits. As discussed below, we are revising our data systems to more accurately track owners' compliance with limitations on admission of ineligible tenants.

The actions the Department has taken to make Section 8 units available for eligible tenants follow:

> In November 1981, the Department published Handbook 4350.3, Occupancy Requirements of Multifamily Subsidy Programs. Paragraph 3-12 of this Handbook sets forth the Department's policy on admission of ineligible tenants. That Paragraph: (1) advises owners that they may admit over-income tenants only when Section 8-eligible tenants are not available; (2) requires owners who admit over-income tenants to certify that they had taken all reasonable steps to attract income-eligible applicants and that such applicants were not available; and (3) advises owners that their failure to adhere to Paragraph 3-12's requirements will be grounds for debarment or suspension from HUD programs. Previously, owners could admit ineligible applicants even when eligible applicants were available and penalties were limited to HUD reducing the number of Section 8 units allowed at the project.
>
> During 1982 and 1983, all HUD Field Offices and project owners and management agents were invited to attend a two-day training session on Handbook 4352.3. These training sessions thoroughly discussed Paragraph 3-12's limitation on admission of over-income tenants. Because many projects did not begin using this new handbook until the first half of 1982 and owners were not required to evict ineligible tenants already in place, the new handbook procedures did not immediately reduce the number of units occupied by ineligible tenants. However, we believe that the handbook procedures have caused owners to place eligible tenants in most of the units that subsequently have turned over and become available for occupancy.
>
> We have designed a new automated system that will be able to track owners' compliance with the limitation on admission of over-income tenants. Called the Multifamily Tenant Certification System (MTCS), this system will distinguish between the two types of over-income tenants discussed above in our remarks on the MIS reports. MTCS should function with reasonable accuracy by mid-Fiscal Year 1985.
>
> We are now finalizing a regulation change that will implement the ineligible tenants provisions of Section 325(1) of the 1981 HCDAs. This regulation will require that owners who are subject to the 1981 HCDA obtain HUD's written approval before admitting any ineligible tenant. Currently, owners need only certify in their own files that no income-eligible applicants could be found and HUD monitors compliance annually. The requirement for advance HUD approval should reduce any owner abuse of these limitations.

TAX-EXEMPT FINANCING

Question: What would the indirect budget savings on subsidized production be if State Housing Finance Agencies used taxable rather than tax-exempt bonds?

Answer: Based on Treasury Department estimates of total tax-exempt bond financing, the estimate of indirect budget savings on subsidized production of rental housing for 1984 using taxable rather than tax-exempt bonds would be about $900 million.

Question: What would the indirect budget savings be if Section 11(b) tax-exempt financing was eliminated?

Answer: The estimate of the resultant savings from the elimination of Section 11(b) tax-exempt financing is approximately $210 million for 1984.

RENTAL HOUSING ASSISTANCE/RENT SUPPLEMENT AND TROUBLED PROJECTS

The 1983 Supplemental Appropriations Act established reserves of $63.4 million of RAP contract authority and $50.8 million of Rent Supplement contract authority to support future amendment needs for non-insured projects.

The Act dictates that future amendments for these projects will cover 90% of the required increase.

Question: Are you experiencing any problems in implementing this legislation?

Answer: The problems being experienced are those of an administrative nature rather than technical or legislative. HUD, because of the closeness of the end of the 1983 fiscal year, decided to fund the 1983 100 percent base in two steps. First, to fund 100 percent of usage, which provided the required funds for the project through the billing cycle and which was completed by September 30, 1983. Secondly, the Department began determining the full base as prescribed by the appropriation Act.

The Housing and Urban-Rural Recovery Act (HURRA) subsequently limited the 100 percent base to those tenants living in and receiving the subsidy on or before November 30, 1983. HUD is now in the process of surveying the State Agency projects to determine what additional amendments will have to be made to set the 1983 100 percent funded base. Once this has been accomplished, we intend to amend the 1984 requests at 90 percent of contract need for rent increases or changes in tenant income. The need to accomplish this will not take place until the last quarter of FY 1984. We anticipate no further difficulty once the 1983 base has been determined and fully funded.

Question: Will non-insured State-aided projects receive consideration for troubled projects funding?

Senator Garn—Continued

Yes. Approximately, $5.7 million has been allocated by HUD to be used by State agencies to assist such projects. HUD intends to provide funds in FY 1985 and subsequent years to State agencies for the program.

Question: Your Budget assumes all insured RAP projects will convert to Section 8 by the end of FY 1985, what happens if a project chooses not to convert?

Answer: We expect that Rent Supplement and RAP owners will take advantage of the chance to convert to Section 8 and thereby insure that their amendment needs are met in future years. We have reported to Congress and the owners that we do not intend to amend Rent Supplement and RAP contracts for rent increase after FY 1985. However, HUD lacks any authority to insist that the contracts be converted without consent of the owner.

Should they choose not to convert, in order for the project to remain viable, owners would have to rent Rent Supplement or RAP units to market rent paying tenants when the units become vacant and conserve contract and budget authority for the remaining units receiving subsidy.

Question: Have plans been made to request any additional authority to amend these projects for increases after 1985?

Answer: HUD has no plans to request additional authority beyond 1985 to amend Rent Supplement and RAP contracts of insured projects whose owners refused to convert to Section 8.

RENTAL HOUSING DEVELOPMENT GRANTS

The Rental Housing Development Grants program will provide State and local governments with grants for new construction and substantial rehabilitation activities. Your FY 85 Budget proposes the use of $200 million in FY 84 to assist 10,000 units and $115 million in FY 85 to assist an additional 6,000 units.

The 1983 Housing Act provides a standard for rents for low-income units. I understand that the Department was considering a strict interpretation of the statute. Under this interpretation, tenants with incomes between 51% and 80% of median income would pay less than 30% of income for rent while families with incomes below 50% of median would be required to pay more than 30% of their income for rent. A more flexible approach would set rents at 30% of any given tenant's income as long as the average of all rents do not exceed 30% of 50% of area median income.

Question: What decisions have you reached as to the way this rent provision will be administered?

Answer: HUD's proposed regulations for the Housing Development Grant Program provide that the rent (including utilities) for a lower income unit may not exeed 30 percent of the adjusted income of a hypothetical tenant family whose gross income equals 50 percent of the area median income, as determined by HUD. The maximum rent will be based on the size of the unit by number of bedrooms, and will not be affected by the actual size, composition or income of the family that ultimately occupies the lower income unit.

Maximum allowable rents for the lower income units in a project will be calculated as follows:

(1) For each affected unit size, HUD will provide the applicable Section 8 very low-income eligibility limit (this will serve as HUD's estimate of an amount equivalent to 50 percent of the area median income) and appropriate standard income deductions (based on the income deductions which are allowed for families assisted under the U.S. Housing Act of 1937).

(2) An adjusted income amount will be determined for each affected unit size by subtracting the applicable standard income deductions from the applicable Section 8 very low-income limit.

(3) The adjusted income amount will be multiplied by 30 percent and divided by 12 to derive the maximum monthly gross rent by unit size.

(4) By unit size, a monthly allowance for tenant-paid utilities and services (if any) will be subtracted from the maximum gross rent to obtain the maximum monthly net rent, which will be the maximum rent that the owner may charge for lower income units of that size.

We wish to emphasize that the above procedures will be used in calculating maximum lower income unit rents: actual rents charged to tenants may, of course, be lower. Accordingly, very low-income tenants with incomes under 50 percent of area median income may not in all cases be required to pay in excess of 30 percent of income for rent and utilities. In fact, HUD will encourage owners and grantees to utilize other additional subsidy resources (i.e., resources other than Housing Development Grant funds) to help assure that lower income unit rents can be made affordable to families under 50 percent of median income. Those applicants which arrange for additional assistance for very low-income families will receive more favorable consideration in the HUD project selection process.

Question: What is the average amount of capital and rent subsidy to be provided for each unit assisted under the Development Grants program?

Answer: For budget purposes, HUD is estimating that the average per unit subsidy cost for projects assisted under the Housing Development Grant Program will be about $20,000/unit but could be significantly higher. The actual average per unit subsidy cost of the program will be affected by a number of factors, including the following:

(a) Development costs of approved projects;

(b) Proportion of approved projects which involve new construction versus substantial rehabilitaiton;

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(c) How approved grantees use grant funds (i.e., extent to which funds are used to provide capital subsidies versus interest reduction or rent subsidies); and

(d) The number of approved projects that contain more than the statutory minimum of 20 percent lower income units.

Question: What has the Department done to define the requirement that the housing produced be of "modest design"?

Answer: In keeping with the requirement of Section 17(d)(9) of the U.S. Housing Act of 1937, as amended, the proposed regulations for the Housing Development Grant Program stipulate that a grant may not exceed an amount "which will provide decent rental or cooperative housing of modest design that is affordable for families and individuals without other reasonable and affordable housing alternatives in the private market." The regulations also require (a) that the estimated value of a project after construction/rehabilitation not exceed the amount of a mortgage that could be insured for the project under Section 207 of the National Housing Act, and (b) that the proposed project costs be determined by HUD to be reasonable. The proposed regulatory restriction on project value and the cost reasonableness requirement should suffice to permit HUD to distinguish projects that clearly are not modest in design.

Question: Although selection preference will be given to projects with high ratios of private and non-Federal funds to proposed grant amounts, does the Department plan to limit the rate-of-return to project sponsors and/or to require a minimum down payment level or loan-to-value ratio?

Answer: The proposed program regulations provide for a HUD determination of whether or not the owner's proposed equity investment is reasonable. HUD intends to clarify in the application packages to be distributed to prospective applicants that a profit-motivated owner's proposed equity investment must represent at least ten percent of the total project cost to be considered reasonable.

HUD does not intend to impose any regulatory limitation on an owner's allowable rate-of-return on equity or to control project rents (other than the rents for lower income units) in an effort to restrict the owner's return. However, the owner's projected rate-of-return on equity will be a factor considered by HUD in its analysis of a Housing Development Grant application. HUD will not approve a grant amount which would enable the project owner to realize an excessive rate-of-return. It should be noted that, in many cases, an owner would be precluded from receiving an excessive return on equity anyway for one or both of the following reasons:

(a) In a number of states, project financing may be obtained from a State or local issuer of bonds only if the owner agrees to a limitation on return on equity.

(b) Assistance to owners under the Housing Development Grant Program is expected generally to take the form of "soft second" loans. Payments due on such loans will be made from surplus cash, which will have the effect of reducing or eliminating the cash available for distribution to owners as return on equity.

Question: Will all projects assisted with Development Grants be eligible for Section 11(B) Tax-Exempt Financing?

Answer: Development Grant projects will be eligible for Section 11(B) financing.

Question: Would such a policy be consistent with the Department's past policy in limiting Section 11(B) Financing to 100% Low-Income Developments?

Answer: The statute under which the Housing Development Grant program was authorized specifically provides that tax-exempt financing be made available (Section 17(j)).

FHA INSURANCE PROGRAMS

In FY 1983, you requested an FHA limitation of $35 billion. In the FY 1983 Appropriations Bill, the Congress increased this to $39.8 billion. Three months after this bill was signed, you requested, and I proposed, an amendment to increase the limit by $6.1 billion for a net total of $45.9 billion.

For FY 1984, you requested $39.8 billion and the Congress provided $50.9 billion.

Question: What has been our experience to date, in FY 1984 - How much of the $50.9 billion have we committed?

Answer: Through March 31, 1984, the Department has committed approximately $10 billion of the $50.9 billion limitation.

Question: For FY 1985, you are requesting $50.9 billion. Given the Housing Recovery, continued high demand for mortgage refinancing, and the authorization of new FHA insurance programs, will the proposed $50.9 billion ceiling on new insurance commitments be adequate for meeting projected housing demand in FY 1984?

Answer: Based on the Department's estimates of application receipts, the $50.9 billion will be sufficient to meet the demand.

Question: Was this your request to OMB?

Answer: The original request to OMB was $54.7 billion. This was subsequently decreased when we revised our estimates on overall market demand.

Question: Would the Administration seek to raise this ceiling should it prove to be restrictive?

Answer: If the demand for FHA insurance was expected to exceed the limitation, the Administration would advise Congress of the fact. While it is neither possible nor proper to predict what budget request would be submitted in a theoretical situation, the historical record cited in the prior questions reflects that the Administration has thus far been willing to request increases as necessary.

FHA INSURANCE PROGRAMS

In its FY 1984 Budget transmittal to the Congress, the Administration proposes a wide range of initiatives designed to target FHA insurance programs to those who are unserved or underserved by the private market and to bring existing programs in line with changing mortgage financing conditions. These proposals include the following:

> Elimination of the Secretary's authority to set interest rate ceilings for insured loans. Interest rates, instead, would be negotiated between the borrower and the lender.
>
> Change in maximum loan-to-value ratios for single-family houses. Proposed changes would reduce downpayment requirements for purchasers of modestly-priced single-family homes.
>
> Authority to provide insurance for new financing mechanisms including Adjustable Rate Mortgages (ARMs), Shared Appreciation Mortgages (SAMs), and on a limited demonstration basis, Reverse Annuity Mortgages (RAMs). In addition, the Administration would eliminate certain restrictive features of the Graduated Payment Mortgage (GPM) program and extend this program to multifamily projects.

Question: What is the current status of each of these initiatives?

Answer: FLOATING INTEREST RATES: Elimination of the Secretary's authority to set interest rates was implemented in December 1983. Simultaneously, we lifted prohibitions against the borrower paying discount points. Both interest rates and discount points are now freely negotiable between the borrower and the lender. We do require a re-evaluation of the borrower's financial capacity to undertake the loan if, after the initial underwriting, there is an increase in discount points paid by the borrower or an increase of more than one percent in the interest rate.

LOWER DOWNPAYMENT ON MODESTLY PRICED HOMES: P.L. 98-181 requires that an actuarial study be conducted prior to our implementing this provision. Implementation is conditioned on the study showing that this change would not adversely affect the actuarial soundness of the mortgage insurance programs of FHA. The impact of this risk on our insurance funds is still being analyzed. Concurrently, we are drafting implementating regulations. Since we have historically defined appraised value as the lesser of acquisition costs or appraised value plus closing costs, for consistency, we are employing this definition here as well. This definition benefits the homebuyer since a smaller downpayment results. In this case, it restricts application of the provision to properties on which the appraised value plus closing costs do not exceed $50,000.

ARMs, SAMs, RAMs: Adjustable Rate Mortgages (ARMs) and Shared Appreciation Mortgages (SAMs) were authorized on a demonstration basis. We are preparing regulations on both programs. We have been coordinating our development of these programs with GNMA and believe the success of these programs will depend on their acceptability in the secondary market. In addition, we have been examining means of allocating insurance authority for the approximate 43,500 loans we can insure. This 43,500 is the aggregate for Indexed Mortgages, ARMs and SAMs combined and represents ten percent of our previous fiscal year volume as authorized by the Statute. We expect to publish interim regulations on ARMs by the end of May 1984 which would make the program effective during June 1984. Proposed regulations for comment covering single family SAMs should be published this Summer and for multifamily SAMs this Fall.

The Statute also charged the Secretary with evaluating the use of RAMs. This study is being conducted by our Policy Development and Research (PD&R) staff.

The proposed regulations for multifamily GPMs are under review. Staff is analyzing several models to determine the maximum increase in debt service which should be allowed each year of negative amortization.

FHA INSURANCE PROGRAMS CHANGES

Question: With regard to negotiated interest rates, what were the actual results of the pilot program as to home prices, interest rates, and discount "points" paid by the homebuyers?

Answer: There were two major analyses of program data collected under the negotiated rate pilot program. The first examination covered the initial cases, and the data was heavily influenced by a disproportionate number of refinancings, i.e., 30 percent. The pilot program was begun as interest rates were declining from the highest level in the Nation's history. The second examination covered later experience and during a more normal period when refinancings were less of a factor, i.e., 6 percent. In both analyses, the negotiated interest rate program proved to be an excellent one. Effective rates (contract rate plus points) on negotiated interest rates were lower or equal to regular FHA insured loans in the vast majority of cases, for all types of homebuyers: first-time buyer and previous homeowners. Moreover, for both analyses, in over 90 percent of the cases the negotiated rate was less than the going conventional rate in the area.

With respect to purchase prices, the sample heavily influenced by refinancings had an average purchase price that was 14 percent higher than the regular Section 203(b) program. This reflects the higher incomes of refinancing mortgagors. However, in the examination of more recent cases, the average negotiated rate purchase price was 6 percent lower.

The pilot program found that the negotiated interest rates provided the flexibility needed to tailor the loan to the specific circumstances of borrower and lender. The study found no adverse impact on housing affordability. No evidence of abuses or consumer complaints, either in the cases studied or on an anecodotal basis was found. The homebuyer did have a greater incidence of paying points for negotiated interest rate loans. But since the effective rates on these loans were equal to or lower compared to the Section 203 controlled loans, the higher buyer points tended to be used "to buy down the contract rate."

Question: To what extent will implementation of this change price some potential homebuyers out of the housing market?

Answer: The negotiated rate should enhance affordability. The only possible price effect of the change is to reduce seller's asking prices on homes by the amount of points which sellers formerly had to pay and subsequently capitalized into the sales price. Under the negotiated rate system, the buyer has the choice of "buying down" the interest rate by paying some points or keeping points low by paying a market interest rate; or the seller may share some points if necessary to close the loan.

Question: How does HUD plan to monitor the results of this program change?

Answer: HUD maintains the same market intelligence system created to determine interest rate ceilings prior to the Housing and Urban-Rural Recovery Act. The cornerstone of this monitoring effort is the weekly telephone poll of 30 leading mortgage companies which continues to provide fresh data on predominant contract interest rates, points, and effective yields on FHA home loans. The results of the survey are analyzed and reported to the Assistant Secretary each Friday evening.

The increase in the maximum loan-to-value ratio for modestly-priced homes will reduce downpayment requirements on the most modestly-priced housing and thus encourage the use of FHA mortgage insurance for such homes.

Question: Are mortgages on such homes, for a variety of reasons, generally more risky (higher claim and loss rates) than those on higher-priced homes?

Answer: Yes, there is evidence that the claim rate on mortgages less than $50,000 is higher than those over $50,000, but the magnitude of this differential is not large. In addition, there appears to be a positive correlation between high loan-to-value ratios and high claims rates. We have no data on loss ratios by mortgage amount.

Question: Will this change adversely the actuarial soundness of FHA's insurance funds?

Answer: The effect of this change on the actuarial soundness of the FHA Fund is currently being evaluated by the Department. We would be happy to provide you with the results of this study when its completed.

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Question: What steps--such as more stringent underwriting standards or increased premiums--might be necessary to protect the soundness of the funds?

Answer: We see no imminent threat to the MMIF, but should future actuarial results prove otherwise, a combination of stricter mortgage credit standards and higher premiums could address the problem. HUD also has discretion to: suspend payment of distributive shares to classes of mortgagors whose actuarial experience has been favorable (of the $3.4 billion current reserve, we currently set aside $1.4 billion in the Participating Reserve Account to cover prospective dividends, but these funds can be transferred to the General Surplus Account if needed to pay claims).

Question: Regarding the alternative mortgage instruments authorized, what consumer safeguards--such as full disclosure of potential mortgage payments--are expected to be included in the program regulations?

Answer: With regard to the Adjustable Rate Mortgage (ARM), the HURRA statute prescribes important safeguards for consumers and will be included in the program regulations. Adjustments in the interest rate of the ARM may not result in an increase of more than one percentage point per year, nor increase more than five percentage points over the entire term of the mortgage. At the time of the loan application, the lender must disclose to the prospective mortgagor the nature of the ARM obligation being undertaken. The Department plans to use an Adjustable Rate Mortgage Disclosure form that each mortgagor must sign for this purpose. The Disclosure Form will include (1) an explanation of what an ARM loan is and how interest rate adjustments are calculated; (2) identify the interest rate index, its source of publication and availability; (3) the frequency of adjustments (annually) and (4) a hypothetical monthly payment schedule that shows the maximum potential increases in the interest rate and monthly payments that may occur over the first five years of the mortgage. Also, each year the mortgagor will be notified, at least 30 days in advance of any adjustment to the interest rate and resulting change in monthly payments, of the current value of the index and how the monthly payment adjustment was calculated.

For the Indexed Mortgage (IM), the Department will have a disclosure form that the prospective mortgagor must sign at the time of loan application. This disclosure form will explain how an IM works, identify that the Consumer Price Index will be the index to which adjustments are tied, show a 10 year history of movements in the CPI and how it will affect monthly payments under the mortgage.

The proposed rules for the Shared Appreciation Mortgage (SAM) are still under development. However, appropriate consumer safeguards will be provided.

Question: To what extent will the up-front mortgage insurance premium disqualify or discourage some prospective homebuyers?

Answer: We believe the one-time MIP should have no impact on the qualifications of prospective homebuyers. However, during the implementation of this initiative, many misconceptions were being circulated about this proposal. One of the most prevalent pertained to the adverse impact of one-time MIP on borrower eligibility.

Since the entire MIP can be financed, with the implementation of a provision of the HURRA, there is no difference in the borrower's required downpayment from the old method. The monthly payment to principal and interest under the new method is roughly approximate and may be slightly less in some instances to the combined monthly payments to principal and interest and MIP under the old method. As a result, this change has no real impact on borrower eligibility.

Question: Will this reduce demand for FHA financing?

Answer: Because of a technicality in the original statutory language, the MIP calculation process was somewhat complex and made many in the real estate industry (realtors in particular) hesitant to participate in FHA transactions. As a result, there may have been a slight decline initially in FHA activity. However, with the implementation of the provision in HURRA, the calculation process was streamlined significantly. This, coupled with the material distributed through national trade associations, should alleviate future problems of this type.

Question: Will adding the premium to the mortgage amount (without regard to dollar limits or loan-to-value ratios) create additional risks because of the resulting 100% plus financing?

Answer: While it is true that mortgage amounts exceed the appraised value of the property, we do not believe that this change will substantially increase risk for the Department. Since HUD receives the entire MIP at closing and this amount is equal to the difference between the old mortgage amount and the new including MIP, it has little impact on the Department's risk. Moreover, the borrower now has the incentive of receiving a refund (approximately 90 percent in the first year) if the loan is terminated in the early years.

Question: What steps might be necessary to protect the soundness of the insurance funds?

Answer: Since we do not believe any additional risk has been created, no additional steps are necessary.

HOUSING FOR THE HOMELESS

Question: In addition to the newly authorized emergency shelter provision, what plans does the Department have to provide assistance to the growing number of homeless individuals?

Answer: The Department is acting on several fronts through a variety of programs to address the needs of the homeless population.

The most effective use of Federal Government resources has been through the public-private sector partnership embodied in the Federal Interagency Task Force on Food and Shelter and the excellent work of the National Citizens Committee for Food and Shelter, Inc. In an unprecedented display of inter-agency and inter-governmental cooperation, several pieces of the funding or in-kind support services puzzle have come together. Depending on the community under discussion and its particular needs HUD-held property may be leased, Community Development Block Grant funds may be used to rehabilitate properties, the General Services Administration may supply surplus government furniture, Federal Emergency Management Agency funds may be used for operating costs for homeless shelters, and local church or social service agencies may provide needed social services and maintenance work. The mix of multi-levels of government and private and public sector interests has created an atmosphere in which these unique shelters can operate effectively. The most prominent and effective use of this housing option which is presently being utilized is in Memphis, Tennessee were ten houses are being used to house homeless families.

In addition, we have determined that Community Development Block Grant funds may be used for the acquisition and/or rehabilitation of property for use as a shelter for the homeless. In addition, the operating cost of a shelter is an eligible public service activity in the CDBG program. In an effort to learn the extent of use of CDBG funds for these purposes, the Department recently requested this information from CDBG grantees. The figures were impressive. Over $39 million of CDBG funds has been committed by 175 grantees to activities for the homeless. The major portion of these funds is being spent on the direct provision of shelter; the lesser portion is being spent on support such as counseling, food, clothing, medical aid and relocation assistance.

On another front, the Department has identified and made available a number of (Special Risk or General Insurance Fund) HUD-held single-family properties to communities in need of this type of facility for the homeless. The Department has agreed to lease to mayors and/or local organizations single family properties in the HUD-held inventory for a nominal fee of $1 per year. The Secretary has instructed Regional Administrators (RAs) to play an active role in making these properties available. Interested mayors of community organizations can simply request through the RA or local HUD office the list of available properties for the purpose of providing housing to the homeless. These properties will be pulled from the list of offerings made to the general public and a lease arrangement will be drawn up.

Finally, Secretary Pierce has advised our Regional Administrators that local Public Housing Authorities should be notified that eligible homeless persons can be given priority when Section 8 Housing Certificates are distributed.

Question: How long will it take the Department to write the regulations for the Section 216 program?

Answer: The Department is not requesting an appropriation to fund the Emergency Shelter program (Section 216) since local authorities and private charities are more attuned to local needs and can respond more quickly. In addition, the problems of the homeless rarely relate to the lack of available shelter but instead to socio-economic problems. The Department is taking action on this issue by utilizing existing resources as outlined in the previous answer.

Question: Given this schedule, when would you expect to obligate funds and when would you expect actual shelter rehab to occur?

Answer: As noted in our response to the previous question, the Department is pursuing other means to assist the homeless and is not requesting an appropriation to implement the Section 216 program.

ACQUIRED MULTIFAMILY HOUSING PROJECTS

As of September 30, 1983, HUD owned 113 multifamily projects that cost more than $124 million to acquire. When HUD acquires a defaulted project, its primary objective is to dispose of it at the earliest possible date at the highest price obtainable. In the past, HUD would initiate a program to repair and rehabilitate the project in order to bring it up to standard and to make it more marketable. In November 1981, however, HUD changed its repair policy so that in most cases repairs will be made by the purchaser rather than HUD.

Question: What is your current policy for disposing of multifamily projects which are in such poor physical condition that it is not feasible to require that they be rehabilitated?

Answer: Few projects acquired by the Department fall into the category described above. In the event such a project is acquired which is serving also as a lower-income housing resource, HUD will assure that eligible tenants will have decent, safe and sanitary housing available to them and that permanent relocation is minimized.

The Department is including language in its contract of sale and other closing documents for projects sold with the condition that repairs be performed by the purchaser which permits HUD to take back title to the property should the purchaser fail to perform the required repairs.

Question: Has it been necessary for HUD to use this provision yet, and does the Department believe this provision will sustain a legal challenge?

Answer: The Department is expected to enforce this provision shortly in a case involving a vacant project in Tennessee. The Department believes that the provision will sustain a legal challenge.

On January 23, 1983, the Assistant Secretary for Housing-Federal Housing Commissioner sent a memorandum to the HUD-Field Offices indicating HUD was spending enormous amounts of money to pay real estate taxes on HUD-owned projects, and on projects where HUD is in control as mortgagee-in-possession. He instructed the Field Offices to seek tax appeals, as appropriate, in order to obtain tax reductions on projects.

Question: Does HUD intend to assign its rights to the tax appeal, including any subsequent refunds to the purchaser?

Answer: It has always been HUD policy to seek reassessments and rebates of excessive local property taxes. The January memorandum was intended to remind field staff of this policy and to direct them to file for tax appeals where such action appeared to be warranted.

The Sales Contract used in multifamily property disposition contains language that assigns to the new owner any rights HUD might have to receive a tax rebate. The major reason why HUD assigns its rights is that the Department has had only limited success in winning tax appeals. In general, HUD has found that local officials are usually more sympathetic to the local property owner than the U.S. Government. In addition, if HUD were to retain these rights, the Department would be faced with a difficult tracking and enforcement problem. There is flexibility in this area and when HUD is fully assured that a large rebate will be awarded, the Department will either retain rights to the rebate or inform potential bidders of the amount to be received.

In order to more clearly explain the assignment of these rights, the Sales Contract language has been revised for clarity in this area. The following quote is from the revised Sales Contract:

"Purchaser shall have Seller's rights to any real estate tax refunds not received by Seller by the Closing Date, including any rights to refunds pursuant to any pending litigation or administrative proceeding."

Question: Is HUD making this fact known to all bidders in its advertisement of project sales so that the bidder might reflect the potential tax refund in their bid price?

Answer: Yes. If there is a possibility of a tax refund, it will be noted in the Prospectus which is distributed through a nationwide mailing list. It would be incorporated also into the Bid Kit prepared for each sale.

Question: Because any successful appeal would involve a refund of taxes for which HUD actually paid, will HUD receive some proportion of any subsequent refund?

Answer: The Department would not directly receive any potential tax refund if awarded after the sales closing date, unless it was so stated in the terms of sale. However, it is expected that a potential tax refund would be taken into consideration by bidders and reflected in the bids received.

Question: What new procedures have been put in place since last year to ensure that its Field Offices do an effective job in monitoring the activities of on-site managers to reduce costs and unnecessary expenditures? Would you briefly describe, for the record, the status of recent contracts to provide property management and financial services for HUD-owned multifamily projects?

Answer: In 1983, a two-year Property Management System (PMS) contract was executed to obtain automated project-based financial management and accounting services for the Department's HUD-owned and Mortgage-in-Possession (MIP) projects. PMS went "on-line" for the nation in August 1983. PMS provides for field office establishment of annual budgets, centralized bill payment and oversight of operating costs through computer-generated reports. Property managers receive operating statements and cash disbursement reports on a monthly basis which help ensure that the budget established for the project is not exceeded. The contract can be extended for up to three additional years.

TAX LAWS AND HOUSING

Question: What was the annual amount of tax expenditures related to rental housing over the past 5 years?

Answer: As a general response to this question and to the other questions that follow on tax expenditures, it should be noted that data has not been provided for the 4 years prior to FY 1983 because of changes in the methodology used by the Treas-ury Department to calculate tax expenditures. These changes were implemented at the start of FY 1983. Data on tax expenditures is available for the period FY 1983-85 and is part of the Special Analysis of the Budget for Fiscal Year 1985.

For rental housing, tax expenditures include accelerated depreciation on rental housing, 5-year amortization for housing rehabilitation and the exclusion of interest on state and local debt for rental housing. Tax expenditures are reflected in the Special Analysis at $1,465 million for FY 1983, $1,780 million for FY 1984, and $2,025 million in FY 1985.

Question: What portion of these tax expenditures can be attributed to assisted rental housing?

Answer: Tax expenditures for assisted rental housing are based on the relationship of HUD and FmHA subsidized insured rental housing starts to total rental housing starts. Tax expenditures are estimated at $335 million in FY 1983, $408 million in FY 1984, and $464 million in FY 1985.

Question: To what extent have the tax expenditures for all rental housing and for assisted rental housing added to the Federal budget deficit?

Answer: If the tax expenditures were reversed and collected as tax receipts, the Federal budget deficit would be reduced by the above estimated amounts. However, we have no way of knowing how investment decisions would have been altered by a change in tax laws or rental housing--and, therefore, it is impossible to know what the real impact of eliminating any specific tax expenditure item.

Question: Please provide the same information for non-assisted home ownership.

Answer: Tax expenditures for homes include deductions for interest and property taxes and the exclusion of interest on state and local housing bonds for owner-occupied housing. Tax expenditures are estimated at $29,036 million for FY 1983, $32,062 million for FY 1984, and $34,887 million for FY 1985.

Question: What are the Department's views on the need to maintain distinct tax preferences for low-income housing over conventional housing, and for new rental housing construction over used rental housing?

Answer: Section 2 of the Housing Act of 1949 expressed the national goal of "a decent home and a suitable living environment for every American family." Section 2 of the Housing and Urban Development Act of 1968 pointed out that one of the ways to achieve this goal is "the fullest practicable utilization of the resources and capabilities of private enterprise." Few low-income projects are able to generate cash from operations that is sufficient to provide an incentive for investment by private enterprise. Tax benefits can offset insufficient operating revenues so that private enterprise has an incentive to make investments in low-income projects that would otherwise be divered to other investment opportunities. Federal tax preferences also provide an alternative to direct federal subsidies that would otherwise be needed to keep rental payments at a level that low-income families can afford. Consequently, the Department favors the continued availability of tax preferences to meet market demand for new and existing low-income rental housing.

The following tax preferences illustrate the type of incentives that encourage private enterprise investment in low-income housing. The higher rate of accelerated depreciation under IRC 168(a)(2)(A) encourages not only new construction but also the infusion of additional capital into existing projects. The phased reduction of accelerated depreciation recapture under IRC 1250(a)(1)(B) provides an incentive for retention of project ownership, and IRC 1039 encourages retention of a project's low-income identity after the sale of a project. Long-term use of a project for low-income housing is a prerequisite for tax-exempt funding under IRC 103(b)(4(A), and the modernization of existing projects is encouraged by the favorable rate for depreciation of rehabilitation expenditures under IRC 167(k). These types of tax preferences not only stimulate investment in new and existing low-income housing but also aid in the reduction of direct federal rent subsidies that would otherwise be necessary to maintain the low-income character of a project.

RESYNDICATION OF FEDERALLY-ASSISTED MULTIFAMILY PROJECTS

Resyndication is the concept of selling the ownership interest in an existing property to a new group of investors. These investors are primarily motivated by their ability to take tax deductions on the project, most notably accelerated depreciation, to generate large tax losses against which their other income can be "sheltered". At the end of 1983, an estimated 1,000 HUD projects have been resyndicated.

Question: What steps has the Department taken to coordinate with the Department of Treasury on the salient tax issues affecting resyndicated multifamily rental housing, particularly the valuation of resyndicated projects and the use of secondary financing in these projects?

Answer: At HUD's request, Treasury is currently reviewing the tax consequences of resyndication of this type, but has made no final determinations.

Question: Has the Department developed procedures for providing the IRS with information on project owners who fail to comply with HUD's rules and regulations for project transfers?

Answer: Quarterly reports of all transfers (and foreclosures) are provided to Treasury.

Question: What is the Department's current position regarding its regulations prohibiting the compensation of a nonprofit owner/seller when a project transfer is proposed to a profit-motivated buyer?

Answer: Monetary remuneration is permitted only in accordance with the criteria contained in HUD's directive of May 4, 1983. This directive provides that Headquarters will only consider requests for waiver of 24 CFR 265.13 which propose that the remuneration to the non-profit seller be placed in a trust, the purpose of which must be the furtherance of a public service as determined by HUD. In addition, no remuneration may pass to any individual connected with the non-profit seller and the non-profit seller may only transfer the remuneration after the purchaser has actually made a cash contribution to the project in an amount equaling ten percent of the unpaid mortgage balance or an amount necessary to restore the project to sound physical and financial condition, whichever is greater.

Question: How many exemptions to this basic policy have been granted, and for what reasons?

Answer: It is estimated that not more than four per month have been granted for public benefit reasons as set forth in our criteria.

Question: What plans has the Department made for evaluating its performance in approving the transfers of Federally-insured or HUD-held projects?

Answer: HUD's Office of Policy Development and Research has been requested to assess the options for evaluating this issue and anticipates a decision within the next 60 days.

Question: Does it plan to evaluate the costs and benefits of resyndication and/or its impact on project tenants?

Answer: Yes, at the present time.

IMPROVING CONTROLS ON MULTIFAMILY HOUSING

Question: Could you please comment on the conclusions and recommendations on GAO's April 11 report entitled "Improving Controls Over Rent and Management Fees at Multifamily Housing Projects"?

Answer: This GAO audit concludes that inadequate supervision and unclear or incomplete handbooks guidance are reducing the Field Offices ability to assure that projects' rents, management agents' fees and project subsidies are reasonable. The Department agrees with the report's conclusions and is now in the process of implementing the recommendations presented in the report. New management fees and new rent increase procedures are planned to be published this summer. The procedures will address the topics covered in the GAO's report.

SINGLE FAMILY MORTGAGES

Question: What is HUD doing in response to the increasing number of homeowners in default that are and threatened with the loss of their homes?

Answer: HUD provides assistance to homeowners in default through its current assignment program. This program is designed to protect qualified homeowners who, due to temporary circumstances beyond their control, could not fully meet monthly mortgage obligations and were treatened with foreclosure. While the mortgage is in assignment, the Department may reduce or suspend mortgage payments for a period of up to 36 months to enable the homeowner to resume full mortgage payments.

Question: Are more mortgages being taken on assignment and if so, what is the increased cost?

Answer: The 1985 Budget projects that 4,185 units would default and be assigned to HUD in 1984 at an average claim cost of $37,500 per unit. This compares with actual activity in 1983 when 5,447 units defaulted and were assigned to HUD at an average claim cost of $34,300.

The estimated lower level of assignments in 1984 reflects the implementation of the Temporary Mortgage Assistance Payments (TMAP) program. The 1985 Budget estimated that 1,215 homeowners would be assisted under the TMAP program. Without this program, it is assumed that these homeowners will have their mortgages assigned to HUD.

Question: Is HUD actively involved in trying to have the mortgagees and homeowners work out problems concerning defaults before the mortgage is assigned to HUD?

Answer: Yes, HUD requires a mortgagee to contact the homeowner to determine the reason for default. The Department encourages the use of repayment plans to help the homeowner become current and also encourages mortgagees to suggest to the homeowner that a HUD-approved counseling agency be contacted for help. HUD field offices were recently instructed to more closely monitor mortgagees' efforts to work the problems out with the homeowners. The instructions emphasized outstanding policy as to the actions field offices may take when they find that a mortgagee has been lax in their efforts to service a mortgage.

Question: What is the mortgagee's responsibility in this regard and what pressures can HUD apply to assure that the mortgagee is protecting the Government's interest?

Answer: The mortgagee has discretion as to type of forbearance relief. However, where the Department finds a pattern of cases where inadequate servicing was provided, and the mortgagee refused field office requests to provide additional servicing, administrative sanctions may be placed against the mortgagee by the Mortgagee Review Board. Administrative sanctions may include their removal from the list of mortgagees approved to do business with the Department.

Question: Given the legal problems with the TMAP program, how much of this money can you realistically expect to obligate in FY 1984?

Answer: None. The Court recently heard arguments from both sides and the Department does not expect an opinion before June 1984. Taking in consideration the time required to print and issue Handbook instructions and then train staff on those instructions, HUD does not expect to obligate funds until FY 1985.

Question: How much are you requesting for TMAP in 1985 and how many homeowners will be assisted?

Answer: The 1985 Budget contains a TMAP request of $65 million for initial assistance to 4,320 homeowners.

FORECLOSURES

In a January 16, 1980 GAO report, it was disclosed that foreclosures of HUD multifamily mortgages were taking an average of over 2 1/2 years to accomplish. Delays were being encountered at various stages, including HUD's Office of General Counsel (OGC) and at the Department of Justice. HUD and the Department of Justice have taken several steps to improve the foreclosure process, including the development of a manual foreclosure tracking system and the development of a model legal instrument for use by the Department of Justice. We also questioned you about this issue at last year's hearing.

This is an issue of significant magnitude since as of January 31, 1984, HUD had an inventory of 1,601 assigned multifamily projects containing about 213,500 units with an outstanding mortgage balance of approximately $3.2 billion.

Question: To what extent has HUD improved the timeliness of the foreclosure process? Can HUD provide statistics to show improvement?

Answer: HUD has improved substantially the timeliness of the foreclosure process. For cases filed by the Department of Justice in 1981, an average of 8.39 months elapsed from the date of referral to the date on which the complaint was filed in the United States District Court. In 1983, the average elapsed time for cases filed was 2.28 months, a reduction of 6.1 months. It is noteworthy that this reduction in processing time occurred at the same time the number of referrals was increasing. The recent improvement is reflected in the following statistics:

Senator Garn—Continued

JUDICIAL FORECLOSURES

Years	Judicial Cases Files	Average Elapsed Time to File (Months)	Filing Time (Months) (<3)	(<2)	(<1)	Longest (Months)	Shortest
1981	32	8.387	0	1	0	16.3	1.4
1982	55	5.298	0	3	5	17.0	.7
1983	53	2.288	34	8	6	4.9	.4

In 1981, the average elapsed time from referral to filing was 8.38 months and only one case was filed in less than three months from the date of referred. In 1983, the average elapsed time had been reduced to 2.26 months, 48 of the 53 cases had been filed in less than three months, eight of these in less than two months, and six in less than one month.

The improvement in foreclosure processing has been brought about by a number of factors. These include a reorganization of OGC, by which the Office of Program Enforcement was established and assigned responsibility for foreclosures. This resulted in substantial increase in staff resources available for foreclosure work. Additional staff resources have also been allocated in the Office of Housing and the Office of Finance and Accounting. The development, articulation, and dissemination of a clear foreclosure policy with firm but reasonable guidelines, the development and use of a computer-based foreclosure tracking system, the implementation of quarterly foreclosure reports from HUD's Regional Counsel to Headquarters, the increased use of paralegals, and the elevation of HUD foreclosures to a high priority within the various United States Attorney offices have all contributed to the improvement. The management improvements, the aggressive servicing of delinquent loans by the Office of Housing, and the vigorous prosecution of foreclosures by the Office of General Counsel, HUD's Regional Counsels and the United States Attorneys have produced impressive results for HUD.

In 1983, the face value of mortgages foreclosed was $73,501,182, cases received from settlements negotiated after foreclosure was initiated totaled $17,426,746, and an additional $10,676,214 was collected in those cases where HUD was outbid at the foreclosure sale.

Question: Do you have an estimate of the losses that might be reduced as a result of shortening the foreclosure process?

Answer: Shortening the time that is spent in the foreclosure process offers two possible avenues for reducing losses. First, a faster foreclosure hastens the ultimate disposition of the property which will reduce the interest costs caused by Federal borrowing needed to pay off an assignment. Secondly, a shortened time will make it more likely that the property will be in better condition when sold, thus enhancing the expected proceeds. Most importantly, the better condition the property, the more likely the property will serve sucessfully the needs of the tenants in the project despite its financial troubles.

Senator Garn—Continued

PROPERTY DISPOSITION

The purpose of the property management and disposition program of the Department of Housing and Urban Development shall be to manage and dispose of projects in a manner which will protect the financial interest of the Federal Government; preserving and revitalizing residential neighborhoods; maintaining the existing housing stock; and minimizing the involuntary displacement of tenants.

The regulations require that if a project had been formerly subsidized, at the time of sale it will be sold with subsidies attached to the units. Both formerly subsidized and formally unsubsidized units which are serving as a low-income housing resource may not be sold without subsidies if there is a need for such housing within the community.

I understand, however, that in the last several years the Department has sold several projects without such subsidies.

Question: What were your reasons for selling without subsidies units of Section 236 Housing in Atlanta, Georgia (Wheat Street Gardens); 344 units of Section 221(d)(3) Family Housing in Indianapolis, Indiana (Stonekey II); and 184 units of Section 608 Housing in Camden, New Jersey (Everett Gardens)?

Answer: It should be noted that neither the regulations which govern the management and disposition of HUD-owned multifamily property, nor the applicable statutes mandate the provision of subsidy to all units in all projects serving as lower-income housing resources. The Congress and the drafters of the regulations understood, and rightfully so, that the Department needs discretion in these areas. Both the regulations and the statutes permit the use of discretion and a balancing of program goals.

As in the past, HUD intends to assure that eligible tenants have available to them affordable, decent, safe and sanitary housing, and that permanent relocation is minimized. However, the Department must be able to exercise flexibility in determining whether or not such housing will be at the project or alternate sites. In some cases, relocation may be necessary and even desirable for tenants. If tenants have to be relocated during HUD ownership, HUD pays the relocation costs. If relocation is expected after the sale, HUD requires the purchaser to pay the costs.

In the three projects cited, HUD found that alternate decent, safe and sanitary housing was available. HUD did provide subsidies to eligible tenants, in the form of Section 8 Certificates as well as assistance in obtaining alternate housing. Certificates represent a low-income housing resource that remains within the jurisdiction of the PHA. The use of Certificates was determined to be an acceptable alternative to a project-based subsidy.

HUD did not require that the new owners repair the projects because repairs or demolition would have been required by local code, and there is no reason for HUD to make such additional requirements in sales without subsidy.

Following are summaries of reasons the cited projects were sold with neither repair requirements nor project-based Section 8:

Wheat Street Gardens II

The project had a long history of security problems caused by severe design deficiencies causing, in HUD's estimation, potentially excessive long-term operating costs. The cost of guard service during HUD-ownership was over $10,000 per month. While rehabilitation solely to code may have been feasible, the additional costs to cure the security problem and provide "defensible space" were not.

HUD was sued on this case in an attempt to show that the decision, not to provide a project-based subsidy was improper. A Temporary Restraining Order was requested to stop the closing which was denied, and the sale was closed. The Court has not yet issued a decision on the case.

Stonekey II

HUD determined that there were sufficient decent, safe and sanitary housing units available in Stonekey I, across the street, to house eligible tenants of Stonekey II. Also, the existing sizes of the units in the project did not meet local needs for larger units, and the cost to rehabilitate units to meet those needs exceeded 85% of replacement costs.

Everett Gardens

The project was in deplorable condition when acquired by HUD. It is located in a declining area of Camden, New Jersey, bounded by a scrap metal yard, railroad span, a major highway overpass and vacant and abandoned single family structures. HUD determined that rehabilitation was not feasible because of excessive rehabilitation costs of about $30,000 per unit. HUD also found that there were sufficient numbers of vacancies in the area to accommodate displacement needs. The New Jersey Department of Community Affairs (NJDCA) provided 72 Section 8 Certificates to eligible tenants to provide for prompt relocation necessary because of the poor physical condition and location. HUD later provided NJDCA with funds for 72 replacement Certificates.

Question: Is it true that in the Atlanta case, the Department sold the project "as-is" because it claimed, as one of the reasons, that there were no property disposition subsidies available?

Answer: No. The reasons for the sale of Wheat Street Gardens II were as noted previously.

Question: How does this relate to the fact that this Committee and the full Congress included funds for an additional 7,000 units of property disposition in the Supplemental Appropriation Bill last year?

Answer: The Department had sufficient property disposition subsidies available in FY 1983--the decision on the Atlanta project was based on infeasibility--not lack of subsidy funds.

Question: Why couldn't some of these additional units been utilized to provide project-based subsidies in all of these cases?

Answer: If HUD has determined there was need to preserve these projects as assisted housing, and it was financially feasible to do so, such a program could have been used. However, HUD's analyses did not show this to be the case.

I understand that in the Camden, Atlanta and Indianapolis dispositions, the Department claimed that the level of rehabilitation required to bring the units up to standard was too expensive for the property disposition program.

Question: What analysis was made by HUD to show that rehabilitation was not feasible with property disposition subsidies?

Answer: The replies above specifying the reasons for not requiring rehabilitation of these projects also respond to this question.

Question: Does HUD make any guarantee that these units will be repaired to any decent, safe and sanitary housing standard?

Answer: While we have no "guarantee" that any project will be repaired to such condition, we do make provisions to ensure that these properties meet decent, safe, sanitary standards.

In 1983, the Department allocated 8,213 units of property disposition, after you requested funds for 17,000.

Question: Why is this? Have fewer units been coming into HUD's inventory or is it that they are leaving at faster rates?

Answer: The following program data reflects the number of property disposition sales actually closed in FY 1983, not those for which sales were simply approved and Section 8 allocated. Note that these numbers also reflect Section 8 allocated from more than one fiscal year. Likewise, Section 8 allocated in FY 1983 will be used in FY 1984 sales closings.

	Total Closed	Closed w/Subsidy	Closed w/o Subsidy
FY 1983 units	15,924	9,337	6,587

The subsidy used was allocated as follows:

	Units
Certificates	1,050
HAP Contract:	
Existing	5,152
Moderate Rehabilitation	2,736
Substantial Rehabilitation	399
Total	9,337

It must also be noted that property acquisition was less than anticipated, as follows:

	Estimated	Actual
FY 1983	11,900	6,299

Since about 75-80 percent of the inventory being acquired is formerly subsidized, the Department would have used substantially more subsidy had acquisitions been closer to the estimated level.

In a memorandum issued early in 1984, HUD Assistant Secretary Maurice Barksdale stated that the elimination of the Section 8 Substantial Rehabilitation program by the 1983 Authorization Bill also prohibits the use of substantial rehabilitation levels of subsidy for property disposition. In response to Congressional inquiry, HUD has also claimed that there is no need for Section 8 Substantial Rehabilitation for property disposition because only 700 such units were assisted in FY 1984, and that other unspecified techniques are available to ensure the rehabilitation and preservation of the units.

Question: What other specified techniques are available?

Answer: The Department does not believe that the lack of Substantial Rehabilitation Section 8 will have a significant impact because it has been infrequently used in the past and the majority of projects can be sold using Moderate Rehabilitation Section 8 rent limits. There are several options available which can be used in the rare case where acquisition and rehabilitation by a purchaser is not feasible within those rent levels.

1. HUD could require that part of syndication proceeds be used to offset some of the rehabilitation costs.
2. Cities could issue tax-exempt mortgage revenue bonds, thereby lowering the cap rate and increasing the amount available for rehabilitation.
3. Community Development Block Grants funds could be used.
4. The Coop Bank could provide a source of funds for cooperative conversions.
5. HUD could consider the demolition or combination of units to enhance project viability and reduce costs.

HOUSING FOR THE ELDERLY AND HANDICAPPED

Please provide a table showing the number of units Congress appropriated Section 202 funds for, the number of units reserved, the number actually constructed, and the corresponding per unit costs for FY 79 to FY 84.

	1979	1980	1981	1982	1983	(Est.) 1984
Appropriated ..	21,200	20,440	18,800	16,933	14,000	14,000
Reserved	22,525	18,720	15,166	16,038	14,308	14,000
Completed	9,320	16,418	27,968	24,072	20,681	15,000
Average Cost ..	$34,287	$38,267	$42,774	$41,500	$42,300	$44,700

Question: Why aren't you recommending that the elderly and handicapped needs be met through a certificate program rather than new construction?

Answer: Elderly or handicapped persons are participating in the Section 8 existing certificate program and will be eligible for the proposed Section 8 Voucher program. We continue to recognize the special nature of and unique need for housing designed for the elderly and handicapped. The housing projects must be designed to provide access to a range of necessary services for the occupants. The Section 202 new construction program provides new units, designed specifically for the elderly or handicapped.

Question: What percent of the Section 202/8 program units are being utilized for the handicapped?

Answer: In FY 1983, a total of $59 million was reserved for over 1,600 units of housing for the handicapped representing 12% of the total units reserved in FY 1983. This does not count accessible units in projects for the elderly, which are provided based on local need. In the absence of a determination of local need, 10% of the units in a project for the elderly must be physically accessible to the handicapped.

Through FY 1983, a total of over 100,000 Section 202 units had been completed. Of this amount, approximately 5,583 units were in projects designed totally for the handicapped.

Question: Please describe the current status of competitive bidding on Section 202 construction projects.

Answer: Implemented by HUD during 1983, competitive bidding is required only when project loan amounts exceed $2 million or when the projects exceed 110 percent of the new construction Fair Market Rents. Therefore, where cost benefits truly exist in the competitive bidding approach, they should be reflected in rents that do not exceed the FMRs. The loan amount exemption excludes a significant portion of the projects. For example, 215 of the 321 projects chosen in the FY 1983 selections are under the $2 million level.

Question: What are your estimates of the potential cost savings associated with competitive bidding?

Answer: HUD recently made a special study of 12 projects that have used the competitive bidding process. All projects were subjected to regular HUD estimate of costs. Competitive bidding was used to obtain a general contractor rather than the usual method of negotiation. The results show that 759 units were built at an average savings of $3,837 per unit. The average savings per project were $242,662 - for a total savings from all 12 projects of $2,911,952. This clearly is a more efficient use of budget resources for the Section 202 program.

HOUSING FOR THE ELDERLY AND HANDICAPPED

Your 1985 Budget proposes that Section 202 loans be offered at the same interest rate as outstanding Treasury borrowings plus a 1/4 of one percent administration fee. This would mean an expected interest rate of 10.30% in 1985—an increase over the 1983 and 1984 interest rates which Congress capped at 9.25%. Because Section 8 subsidies are available, the increased interest rate should not affect rent payments of low-income residents who are able to rent units in these facilities. However, the higher interest rate will mean that fewer Section 202 units can be assisted in 1985. You also propose to reduce the number of assisted units from 14,308 in 1983 to approximately 10,000 in 1985.

Question: Are Housing vouchers intended to pick up any slack resulting from the proposal to decrease the number of assisted units to 10,000?

Answer: Housing vouchers are not specifically designed to pick up any slack resulting from the decreased Section 202 funding. The Administration believes that the 10,000 unit level for the Section 202 program, along with the availability of Section 8 Certificates and Vouchers, will be sufficient to meet the needs of the elderly or handicapped.

Question: How many Housing vouchers will be earmarked for elderly and handicapped persons?

Answer: There will be no "earmarking" for the elderly or handicapped under the Voucher program. However, historically, over 40 percent of the Section 8 completed units have been occupied by the elderly. A similar proportion is likely under the Voucher program.

Question: Based on your assessment of existing Housing stock, are there a sufficient number of existing units available which are designed to meet the special needs of elderly and handicapped persons?

Answer: The existing units available do not necessarily meet all the special needs of the elderly or handicapped but this is offset to an extent by the Section 202 program.

Question: Will the value of a voucher be sufficient to make units (comparable to those in Section 202 facilities) affordable to elderly and handicapped persons?

Answer: Because the program relies on existing housing rather than costly new construction, the per unit cost of the housing voucher will be less than that of a Section 202 unit. However, the value of the Voucher from the tenant's perspective is that it affords greater flexibility and more options. Since many elderly and handicapped persons do not require special facilities, they have had success in utilizing the Section 8 Certificates for conventional housing. We therefore expect that they will realize similar success with vouchers, with the added benefit that they will have an even greater range of housing opportunities. The Voucher is not intended as a substitute but rather can be expected to augment the Section 202 program. Moreover, elderly and handicapped individuals would not be required to move under these programs once they have located suitable housing.

Question: How many of the 10,000 Section 202 units in your FY 85 Budget will be accessible to handicapped persons, and how does this compare to the number of handicapped individuals on waiting lists?

Answer: Based on past experience, 10-12% of the units reserved can be expected to be in projects designed solely for occupancy by the handicapped. In addition, about 10% of the units in elderly projects are accessible to the physically handicapped. We have not maintained waiting lists for these individuals.

Question: What was your original request to OMB for Section 202?

Answer: The original request to OMB for Section 202 was $700 million of loan authority to support 14,000 units.

HOUSING FOR THE ELDERLY OR HANDICAPPED/ NONPROFIT SPONSOR ASSISTANCE

Question: What has the Department done to increase minority participation in the Section 202 program?

Answer: During March and April 1983, the Department conducted six seminars throughout the country for minority business organizations on the Section 202 program. As a result of this outreach program, together with the establishment of regional goals for selection of minority borrower/ sponsors, the Department funded a total of 70 projects and 3,878 units in FY 1983 for minority organizations.

Question: There were a number of bills proposed during the last session to expand funding for the Section 202 program, revamp the funding procedures and open eligibility to limited dividend sponsors (Heinz/Lundine Bill). Does the Administration support these initiatives?

Answer: The Administration does not support these initiatives. We believe that the Section 8 and 202 programs along with housing vouchers will continue to adequately serve the needs of the elderly.

Question: Why was the number of non-profit sponsor assistance loans for 1983 so far below the original estimate of program activity for 1983?

Answer: The demand for Section 106(b) assistance is generally heaviest at the front-end, i.e., loan application and fund reservation stages. For example, although there were only 15 loans made during FY 1983, the Department actually reserved funds for 34 approved Section 202 borrowers during this same period. These 34 new fund reservations are in addition to the 15 loans in the year and will convert to loans in the subsequent fiscal year. There were 159 Section 106(b) fund reservations outstanding at the end of FY 1983 and any number of these could conceivably convert to loans in this year.

CONGREGATE SERVICES PROGRAM

This year, you are not requesting any additional funds for the Congregate Services Program in FY 1984.

Question: When is an evaluation of the demonstration program anticipated to be made public?

Answer: The contractor is scheduled to provide the Final Impact Report, which measures the effectiveness of the demonstration program, to the Department by December 1984. We will submit these findings to the Congress as soon as possible thereafter.

Question: Please provide for the record, the total number of tenants served and the cost per tenant.

Answer: During Calendar Year 1983, a total of 2,222 persons were served at an average cost of $3,000 per person.

Question: Will you require any additional funds in order to support the existing Congregate Services projects during FY 1985?

Answer: Twenty-nine projects are expected to run out of funds in FY 1985, and it would cost approximately $4 million per year to extend them for a period of 18 months.

MANUFACTURED HOME INSPECTION AND MONITORING

Question: What is the proposed rule which would permit HUD to change the method of fees collected for the manufacture of mobile homes?

Answer: During 1984, a rule change is being proposed which would allow HUD to change the method of determining fee collections. Under the proposed rule, a $16 fee would be charged for each transportable section of each manufactured home produced. (A single-wide manufactured home is comprised of one transportable section, whereas a double-unit is comprised of two transportable sections.) Therefore, single-width units would be charged $16 instead of $19 and double-width $32 instead of $19. It is assumed that approximately 24 percent of the units produced will be double-width.

Question: What proportion of the program's administrative costs are covered by the fees collected?

Answer: The fee income is estimated to pay fully the administrative costs of those HUD staff assigned to inspection-related activities. This staff represents approximately 75 percent of the total staff assigned to the Manufactured Home Inspection and Monitoring program. The cost of supporting the inspection-related staff is estimated at $1,002 thousand in 1984 and $1,051 thousand in 1985.

INTERSTATE LAND SALES

Question: What changes to the existing fee structure is the Department proposing in the FY 1985 Budget?

Answer: During 1984, the Department plans to revise the existing fee structure in order to provide additional receipts to offset a larger portion of the administrative expenses. The proposed revisions follow:

Revised Fee Proposal

Registration:

The present sliding scale charges up to $1,000 for 501 or more lots. This would be changed to a flat fee of $800 for 200 or less lots and $1,000 for more than 200 lots.

Advisory Opinions/Exemption Orders:

The present fee of $250 each would be raised to $500.

Amendment Fee for Annual Activity Report:

An activity report will be required that reflects the annual ending inventory of lots. If this inventory is 100 or less, no fee will be charged. If the subdivision has over 100 lots in ending inventory, the fee will be $800.

FY 85 CIAP FUNDING

I understand you have allocated about $1,432,000,000 of the $1.55 billion in CIAP funds to your Regional Offices. The remaining $118 million is being held at Headquarters.

Question: For what purposes are these funds being held at Headquarters? On what authority are you withholding the $87 million for development to modernization swaps? Are you aware of the language in the House report on the Housing Supplemental (H.J. Res. 517) that directs the Department to release all of the CIAP funds? I understand that you also intend to withhold the additional $62.9 million CIAP funds provided by the H.J. Res. 517 for the swaps -- is that true?

Answer: The Department has assigned $1,432,256,253 to the Regional Offices as of April 18, 1984 out of the $1.55 billion of budget authority available in FY 1984 for the Comprehensive Improvement Assistance Program (CIAP). Of the approximately $118 million being held in Headquarters, $30,725,747 is remaining from the

$40 million originally withheld for modernization adjustments. The remaining amount of approximately $87,018,000 is being held in Headquarters to effectuate the exchange of development funding for modernization funding. This exchange of funding is authorized under the Housing and Urban-Rural Recovery Act of 1983. The Department is aware of the language in the House Report on the Housing Supplemental (H.J. Res. 517) and fully intends to assign all CIAP funding to the Field Offices. When the Department receives the $62.9 million from the 1984 Supplemental Appropriation, it intends to utilize this funding for the exchange of development funding for modernization funding.

DELINQUENT RENTS

Collecting past-due tenant rents is a particular problem for Public Housing Authorities. In addition, project managers are hesitant to evict low-income tenants, and collections from tenants who vacate public housing owing rent are minimal.

Question: What is the total cumulative amount of delinquent public housing rent as of the end of FY 83? How much became delinquent during FY 83?

Answer: The Department does not maintain data on a national basis which indicate delinquent rents owed to Public Housing Agencies (PHAs). Information relative to rent collections is reported routinely by PHAs to the Department's Field Offices and is used by the Field Offices in their monitoring of individual PHAs. But these data are not accumulated on a national basis. It should be noted, however, that the amount of rents charged is used in the Performance Funding System (PFS) calculation of a PHA's operating subsidy eligibility and no allowance is made for uncollected rents. There is a strong incentive, therefore, for PHAs to minimize rent delinquencies.

Question: What percent of CIAP funding is being devoted to "management improvements" that are focused on increased rent collection and how has this percentage changed over the last three years?

Answer: Data on management improvements was not collected in FY 1981. In FY 1982, the latest year for which such statistics are available, 2.15 percent of CIAP funding was devoted to management improvements. FY 1983 information on CIAP funding for management improvements is not yet available. The Department does not have data indicating the amount used for specific management improvements such as increased rent collections.

Question: What is HUD's policy on vendor payments, that is, payments made by a city's welfare agency directly to the PHA for rent on behalf of PHA tenants who are welfare recipients?

Answer: The Department of Health and Human Services' (HHS) regulations (45 CFR 234.60) detail the conditions under which welfare agencies can provide vendor payments on behalf of recipients of Aid to Families with Dependent Children (AFDC). These conditions include a requirement that there be a specific provision in the State's plan and that there be either evidence of mismanagement of funds or a specific request for vendor payments by the welfare recipient. Vendor payments are not be to adopted on a blanket basis for all families on AFDC. Their use is determined on a case-by-case basis and they are not to be continued for more than two years.

I.G. AUDIT

Question: A recent IG report on audits performed on 16 financially troubled public housing agencies cited numerous problems and recommendations. What are you doing about this?

Answer: In response to the Inspector General (IG) report, several actions already are underway and others are being planned which the Department believes will improve its ability to deal with troubled Public Housing Agencies (PHAs). Several of the recommendations relate to ways that HUD can more effectively ensure that PHAs are functioning as they are supposed to as well as providing better technical assistance to the PHAs. The Department has revised its procedures to expand the definition of a troubled PHA, considerably strengthened its monitoring capability of troubled PHAs' operations, and will expand the use of various operating standards to better assess the condition of a PHA's operations and to measure progress achieved.

Although the Department plans to follow the recommendations related to virtually all of the IG report findings, HUD alone cannot resolve all of the problems facing these large PHAs. For lasting improvements, the localities must become actively involved both through the local unit of government and the public and private sector by providing direct oversight and technical assistance. HUD will continue to do its part in facilitating this kind of participation.

BOND SALES

Last year, your Budget presentation talked about long-term bond sales in 1984. Congress gave you $200 million of budget authority to do these sales in 1984.

Question: How come you have not done them? What have you done with these funds?

Answer: The 1984 Budget proposed that budget authority provided in the Annual Contributions for Assisted Housing account in 1983 be used to support long-term taxable bond sales in 1983 and 1984. That Budget proposed that $1.4 billion of budget authority be utilized in support of bond sales of $575 million in 1983 and $1.2 billion in 1984. However, the Congress released $200 million of budget authority to support long-term financing in 1984 and the Housing and Urban-Rural Recovery Act of 1983 (P.L. 98-181) terminated HUD's authority to utilize the Federal Financing Bank (FFB) as a market place for public housing obligations and restricted HUD from entering into Annual Contribution Contracts unless the obligations are exempt from taxation. The Administration wishes to review the issue of taxable versus tax-exempt financing with the Committees. In the interim, the $200 million of budget authority released for 1984 has not been utilized.

Senator Garn—Continued

Your Budget proposes to sell $1.2 billion of permanent financing instruments to the FFB in 1985. You have included $907 million of budget authority to adjust interest rates from the original contract rates to current market rates.

Question: Did you propose going to taxable financing or was it suggested by OMB? How does this position relate to the action taken in P.L. 98-181?

Answer: The Department's 1985 Budget request to the Office of Management and Budget proposed that HUD sell tax-exempt bonds in the private market to provide permanent financing of Public Housing obligations. Because the Administration's policy continues to be the use of taxable instruments for long-term financing of Public Housing obligations and this is in conflict with the action taken in P.L. 98-181, the 1985 Budget includes language under the Annual Contributions for Assisted Housing account to permit the sale of long-term obligations to the Federal Financing Bank.

SPECIAL ASSISTANCE FUNCTIONS FUND (SAF) AND EMERGENCY MORTGAGE PURCHASE ASSISTANCE (EMPA)

Question: Have the operations of the SAF and EMPA programs resulted in overall profits or losses to GNMA?

Answer: The net costs (losses) to the government of the Special Assistance Functions programs and Emergency Mortgage Purchase Assistance programs from inception through September 30, 1983 are $6,359 million and $1,991 million, respectively.

Question: In 1985, the Department proposed enactment of appropriation language for the forgiveness of Treasury borrowing for SAF and EMPA. What effect will it have government wide -- that is on the deficit?

Answer: Forgiveness of Treasury borrowing will have no effect on the deficit. The savings to the Department are offset by the equivalent loss of income by Treasury.

Question: How much borrowing are we talking about?

Answer: We expect outstanding borrowings from Treasury for SAF and EMPA programs to total $12.5 billion at the start of 1985.

Question: What will happen if the debt forgiveness is not approved?

Answer: We will continue to be required to borrow from Treasury to finance the interest payments due to Treasury on current borrowings.

GUARANTEES OF MORTGAGE-BACKED SECURITIES (MBSs)

Question: Does the Administration plan to gradually eliminate the MBS Program?

Answer: The Budget reflects continuation of the Mortgage-Backed Securities Program in future years at levels consistent with the needs for a secondary market for FHA-VA loans.

Question: The Grace Commission seems to suggest that changes should be made to the size of the guarantee fee and the distributions of the fee between the issuer and GNMA. Are you proposing any changes to the fee structure?

Answer: We are proposing no change to the current guarantee fee structure.

Question: What success has the Department had in attracting new investors?

Answer: In 1975, so-called non-traditional investors comprised 53 percent of all GNMA MBS investors. By 1983, this ratio had risen to approximately 70 percent.

Question: What efforts are currently underway to encourage the private market (conventional mortgages) to develop an MBS program?

Answer: The fully private, conventional market, particularly in the past year, has developed a wide range of new MBS instruments. These new instruments range from standard private pass-through securities, to "fast-pay slow-pay" collateralized mortgage obligations (CMO's), to builder bonds which are issued by subsidiaries of home builder firms and which take advantage of installment sales tax treatment. These securities have been issued by a wide range of firms, including Salomon Brothers, Sears, Lehman Brothers, Pulte, Norwest Mortgage Company, HDMAC (a subsidiary of NAHB), and groups of small to medium scale builders.

INDIAN HOUSING

During FY 83, you were able to show a considerable reduction in the cost of Indian Housing.

Question: What actions made it possible to realize these savings?

Answer: The Department established a cost reduction goal of at least $10,000 per unit on November 30, 1982. To accomplish this goal, Indian Housing Field Offices were directed to: reduce site development costs; eliminate extravagant house designs; interpret the Department's revised Minimum Property Standards as the ceiling for Indian Housing; reduce architectural and engineering costs by revising dwelling plans; and be certain that Indian Housing Authorities (IHAs) have the administrative capability to manage the development of new housing.

During the winter and spring of 1983, a joint Headquarters Cost Reduction team consulted with the six Indian Housing Field Offices and representative groups of IHAs concerning the implementation of the cost reduction policies and procedures. Among the additional cost reduction procedures agreed to were: utilization of an accelerated Turnkey system; limiting the size of units; encouragement of Manufactured or Modular Housing by all Field Offices; revision of plans and working drawings; reduction of IHA administrative cost line items by all Indian Housing Field Offices; and limiting lot frontages and home set backs in the Denver Region. In addition, the joint team and the Field Offices set cost reduction dollar targets for each Field Office.

In May 1983, the Department also undertook an initiative to show IHAs that Manufactured and Modular housing can be built in less time than "stick-built" units and at an affordable cost (under $45,000 including water and sewer facilities). The Department is reviewing applications from 14 IHAs to build over 400 units in 15 States. The Manufactured Housing Institute, State manufactured housing associations, modular housing producers and private developers are working with the Department staff in the implementation of this initiative. The goal is to complete construction of these units by the end of calendar year 1984.

Question: What influence, if any, will the new FHA provision in the 1983 Housing Act have on the cost or availability of Indian Housing?

Answer: The new FHA provision could result in helping middle-income Indian families living in restricted trust areas who are above the statutory income limits for Public/Indian Housing to meet their housing needs if individual Indian families or tribes choose to participate. Middle income Indian families (i.e., those with over $25,000 income) constitute approximately 5-10 percent of the population in Indian areas. The Department does not believe that the FHA Indian Housing program will change Indian Housing costs since the current Indian Housing program generally is based on the single family housing Minimum Property Standards.

Question: What is your most recent estimate as to the Indian Housing need over the next 10 years -- if all those that are eligible were to be served.

Answer: The Department does not have data which indicate whether Indian Housing needs will increase or decrease over the next 10 years as the result of new family formations and the movement of families to and from the reservations. However, Fiscal Year 1983 Bureau of Indian Affairs data on housing needs and 1980 Census data, as adjusted for non-reservation Oklahoma tribes, indicate a need ranging between 58,000 and 59,000 units.

SOLAR BANK

Question: What is the status of the Bank's regulations?

Answer: The Final Rule was published on March 16, 1984 and became effective on April 26, 1984. The Final Rule incorporated comments received on the Interim Rule during the public comment period and directives contained in the Housing and Urban-Rural Recovery Act of 1983.

Question: When does the Department expect all of the funds to be obligated?

Answer: Of the $66 million appropriated to the Bank, $30.1 million has been obligated to 48 participants. Of the remaining $35.9 million, $18.7 million, has been tentatively allocated to all eligible program participants and the Department expects these funds to be obligated by June 30, 1984. It is planned that the remainder of the funds, $17.2 million, will be obligated by September 30, 1984.

Question: When will the funds be expended?

Answer: The Budget assumes that a total of $61 million will be expended during fiscal years 1984 and 1985. It is anticipated that the remaining $5 million will be disbursed during the first-half of fiscal year 1986. These estimates assume there is a demand for these funds. However, the States can only make the funds available for loan subsides and matching grants. It is up to the individual to take the initiative to apply for a loan or grant. The measure of actual interest in this program will be determined largely over the next few months.

CDBG - UNEXPENDED BALANCES

According to the Department's FY 1985 Budget, CDBG obligations through FY 1983 totaled $31.1 billion of which $24.4 billion had been disbursed through letters of credit to local communities and State governments. This leaves a balance of $6.5 billion (21%) of obligated funds not used, $1 billion more than at the end of FY 1982.

Question: What is the breakdown of the $6.5 billion in unused funds according to fiscal year appropriation?

Answer: The Department's 1985 Budget indicated an obligated balance for the CDBG program of $6.5 billion at the end of fiscal year 1983. The following table shows a breakdown of this amount by appropriation year:

Senator Garn—Continued

APPROPRIATION YEAR	AMOUNT (Dollars in Thousands)	PERCENT
1983	$4,105,070	62.9
1982	1,906,629	29.2
1981	361,401	5.5
1975 - 1980	157,281	2.4
TOTAL	6,530,381	100.0

Question: What are the major reasons for unused CDBG funds of $6.5 billion?

Answer: There are three major reasons for the $6.5 billion of unused funds:

1. The nature of the CDBG Entitlement Program has always resulted in a fairly high level of undisbursed obligations. This program provides annual grants to communities that have flexibility in scheduling their program years to fit local priorities, coupled with the fact that many eligible uses of CDBG funds require long lead times. (This pattern was also true of the categorical programs that were superseded by the CDBG program.)

2. The 1981 Amendments, offering States the option of administering nonentitlement funds, required major changes in program regulations which took many months to implement. This delay has resulted in some backlogging of funds. While States have begun using their funds at a rate equal to the new funds approved each year, they have not yet worked off that backlog.

3. The 1983 appropriation of $1.0 billion provided for the CDBG program in the Jobs Bill was enacted in late March of 1983. By the end of the fiscal year, almost all of these additional funds had been obligated but very little was expended.

Question: Does the substantial amount of unused funds represent a lack of capacity by some local governments to effectively administer a CDBG program?

Answer: We do not believe this is a significant factor. A handful of entitlement communities appear to have capacity problems, but they are being closely monitored by HUD staff. In such situations, HUD requires these entitlement communities to develop and follow detailed program schedules. We also provide them with technical assistance and, in rare circumstances when such steps fail to bring about improvements, their grant amounts are reduced.

Question: What are the pros and cons of reducing the CDBG FY 1985 appropriation by some or all of the amount of unspent, prior-year funds?

Answer: From the program's point of view, there are no advantages to such a proposed reduction, but a number of severe disadvantages would result.

First, almost all of these unspent funds have been committed to specific projects and activities and have already been obligated at the local level. If no new funds are approved for a year, of course, the prior year funds would be expended during the year and it would appear as though there were little impact from the lack of new funds. However, even if full funding were restored in the next year, a severe decline in expenditures would occur during the next year because of the lead time involved in carrying out activities under this program.

Second, one-year deletion or severe cut-back in funding would seriously disrupt the local process of citizen participation and planning in the entitlement communities. Typically, such communities begin holding hearings to get citizen input on needs and proposals for the next year shortly after receiving funds for the current year. This means that many such communities have already gone through initial stages of that process for FY 1985, and almost all of them will be at that point by mid-summer.

Another consideration is that many entitlement communities will be relying on FY 1985 funds for the next stage of multi-year activities. Because of the entitlement nature of the program, such communities plan their program in stages, so that funds for especially long term activities are not unnecessarily tied up. One of the objectives of this program is that communities have certainty about their funding annually so that they may plan accordingly. A further complication on this same point is the fact that most entitlement communities coordinate their CDBG expenditures to work in concert with portions of their capital improvement budgeting. A failure to provide the planned CDBG funds for a year would obviously frustrate such efforts.

Question: For the record, please provide the distribution of unobligated and unexpended funds by grantee, including the percent of total grantee funds that are unobligated and unexpended.

Answer: The Department does not have current information regarding the amount of CDBG funds that have been obligated by the local grantees. Therefore, data are not available on the amounts of locally unobligated funds. Grantees are required to report this information only on the annual Grantee Performance Reports (GPRs) at the end of their program year, and these documents, because of their size and complexity, are not entered into the Department's Management Information System.

The Office of Community Planning and Development does, however, code GPR information from a representative sample of 220 CDBG entitlement cities and all urban counties for use in the Secretary's Annual Report to Congress on the CDBG program. Based on the information contained in the 1981 GPRs submitted by these communities, it is estimated that, by the end of their 1981 program year, CDBG entitlement communities had expended approximately 83 percent of their cumulative CDBG funds and had obligated about another seven percent. In short, at that end of that year approximately 90 perent of all CDBG entitlement funds had either been expended or obligated for local projects by local officials.

It should also be noted that the amount of unexpended funds in the CDBG program at any one point in time is not an accurate measure of either a community's need or its capacity to use the funds in a timely manner. The reason for this is that since local officials can establish the starting and ending dates for their CDBG program years, these dates vary considerably. Consequently, the amount of approved but unexpended funds in the CDBG program can fluctuate dramatically from one month to the next. The following table illustrates this point:

APPROVED GRANTS, EXPENDITURES, AND UNEXPENDED BALANCES FOR SELECTED CDBG ENTITLEMENT COMMUNITIES, MARCH AND APRIL 1984
(Dollars in Thousands)

	MARCH 30, 1984		
GRANTEE	APPROVED GRANTS	TOTAL EXPENDED	UNEXPENDED BALANCE
Suffolk Co. NY	$32,454	$28,663	$3,791
Tuscaloosa AL	15,772	14,456	1,316
Bethleham PA	13,781	13,049	732
Babylon Twp. NY	13,512	12,157	1,359
Greenwich CT	4,682	3,888	794
Total	80,201	72,213	7,992

	APRIL 30, 1984		
GRANTEE	APPROVED GRANTS	TOTAL EXPENDED	UNEXPENDED BALANCE
Suffolk Co. NY	$37,007	$29,036	$7,971
Tuscaloosa AL	17,225	14,570	2,655
Bethleham PA	15,429	13,469	1,960
Babylon Twp. NY	15,345	12,461	2,884
Greenwich CT	5,448	3,988	1,460
Total	90,454	73,524	16,930

As this table shows, the unexpended balance of CDBG funds in these five communities more than doubled, from $7,992,000 to $16,930,000, despite the fact that they had expended $1,311,000 during that month. The increase in unexpended funds occurred only because these communities had their FY 1984 grant approved during April. An analysis simply of the amount of unexpended funds for these communities at the end of their program year, i.e., the end of March, would yield different conclusions about their capacity to use CDBG funds than would an analysis at the beginning of their program year, i.e., in April.

Senator Garn—Continued

CDBG-LOW INCOME BENEFITS

In May 1983, Cleveland State University, under a HUD contract, issued a report on a 10-city case study that addressed the impact of deregulating the CDBG program. The report, among other things, concluded that local decision makers were shifting funding priorities, most notably to economic development activities. In addition, while the changes did not appear to have an immediate significant affect on benefits to low- and moderate- income persons, it was believed that future benefits may decline as cities shift program allocations further.

In reauthorizing the program in 1983, however, Congress imposed additional requirements to guarantee that the CDBG program's objectives would primarily benefit low- and moderate-income persons.

Question: What data do you have that would shed some light on this targeting issue -- what changes have actually occurred since 1981?

Answer: It should be emphasized that the Cleveland State study found no evidence to suggest that benefits to lower income persons had declined following the 1981 CDBG statutory changes. Rather, the authors found that in six of the 10 cities studied it could be "anticipated that direct benefit levels would decline in year 9 and perhaps in future years as the sample cities shift program allocations and design in various ways, including reducing their service spending to meet the 10 percent limit." (Emphasis added.)

To the extent that the concern about benefits to low- and moderate-income persons was caused by the 10 percent limit on social service spending and the researchers' anticipation of future major shifts in program activities away from direct benefit activities toward economic development, recent statutory actions and planned 1983 spending by entitlement communities should allay any such fears. The 1983 amendments to the CDBG program increased the limit on the amount of a community's CDBG grant that could be used for public services from 10 percent to 15 percent or the percentage that had been allocated to such activities in the prior year whichever is higher. Moreover, according to data based on the Projected Use of Funds documents submitted by the 220 entitlement cities in the CDBG Performance Monitoring and Evaluation Data base, and the 96 urban counties, the amount of CDBG entitlement funds going to public service and to housing related activities, activities with high levels of direct benefit to lower income persons, increased by approximately $158 million between 1981 and 1983, while CDBG-funded economic development activities increased by approximately $133 million during that same period. Clearly, economic development activities are not, in the aggregate, being pursued at the expense of activities providing more direct benefit to lower income persons.

In summary, the CDBG Entitlement program has always provided a high level of benefit to lower income persons. In the three fiscal years preceding the 1981 changes, local officials reported that 90 percent or more of CDBG entitlement funds were used for activities that qualify under the low and moderate-income benefit test. All indications are that similarly high levels of benefit continued after 1981 and should continue in the future. For example, more than 80 percent of the almost 800 State and local officials interviewed as part of a 1982 HUD study by the Office of Community Planning and Development regarding the effects of the 1981 statutory changes, reported no significant changes were planned in either the relative proportion of CDBG entitlement funds attributed to each of the three national objectives or in the geographic areas to which CDBG funds were allocated.

Question: What adjustments has HUD made in its monitoring and evaluation of the CDBG program given the elimination of the application process and deregulation of the program in order to assure that the funds are targeted as intended by Congress?

Answer: HUD's responsibilities for oversight of the CDBG Entitlement program have changed significantly in recent years. The deletion of the requirement for applications, which were substantially reviewed at the front-end, has made us considerably more dependent on post-award monitoring and evaluation to fulfill our oversight responsibilities. To assure that grantees comply with the specific requirements of the Act and other applicable laws, the Department has undertaken a number of specific steps:

1. Grantee Requests for Assistance. While we do not review final statements to determine the eligibility of activities and compliance with CDBG national objectives, we have informed grantees that they may separately request HUD review. Field Offices respond in writing to all such requests, referencing the specific description upon which the determination is made.

2. Grantee Performance Report. In March of 1983, we issued a new Grantee Performance Report (GPR). The information required in the new GPRs has improved the capacity of HUD Field Offices to evaluate activities undertaken during the grantee's last program year to determine whether, among other things, each activity is eligible and meets one of the CDBG national objectives.

3. HUD Staff Training. By the end of March 1984, approximately 160 Field Office staff were trained in the management of the CDBG Entitlement program. The 3-day course, conducted at five locations around the country, provided detailed guidance on how to review CDBG activities (both in-house and on-site) for compliance with key program requirements, including meeting national objectives, meeting eligibility criteria, and the extent of benefit to low- and moderate-income persons. Particular emphasis was placed on recent statutory and regulatory changes affecting these key requirements. Course participants share such information with other HUD staff and with grantees to foster a clear, mutual understanding of program requirements.

Question. What specific criteria is HUD using to evaluate CDBG program effectiveness?

Answer: The Department of Housing and Urban Development evaluates the effectiveness of the CDBG program in benefitting lower income persons at two distinctly different levels. At the grantee level, the Department performs in-house reviews and on-site monitoring visits. The in-house review checks the accuracy of the information provided in GPRs; compares the local official's characterization of the project areas to census data and other available information; ensures that the document is internally consistent, and identifies potential problem areas, including apparent program benefit deficiencies, for further review during the on-site monitoring. During this on-site monitoring, HUD field staff typically review the documentation maintained by local officials for claimed lower-income benefit levels, visit the site of some projects to verify the project description contained in the GPR, and interview local officials and staff regarding any performance or compliance issues identified in the in-house review.

At the national level, the Department reviews the Grantee Performance Reports submitted by 220 entitlement cities and all 96 urban counties in order to track and analyze low- and moderate-income benefits. These communities were selected using sampling technique designed to allow projections to the entire universe of entitlement communities. The data contained in these GPRs are then analyzed to estimate the amount of CDBG entitlement funds reported by local communities to benefit lower income persons, the amounts allocated to each eligible activity, and the income characteristics of the neighborhoods in which CDBG spending occurs. Two estimates of the extent of lower-income benefits are then generated. One estimate uses the amount of lower-income benefit reported by the locality. The second method combines information on the income characteristics of the project area and the amount of reported direct benefit activities to estimate the extent of lower-income benefit in a community. These low- and moderate-income benefit estimates are then weighted according to the weight assigned that community in the sample, combined with the estimates for the other cities in the sample, and projected to the universe of entitlement communities.

CDBG--LUMP-SUM DRAWDOWN

Under the Community Development Block Grant program regulations, grantees are permitted to draw funds through letters of credit as they are needed for disbursement. In addition to regular drawdowns, grantees are permitted to draw funds in a single lump-sum, and to establish a rehabilitation fund. The major purpose of permitting lump-sum drawdowns is to leverage interest subsidies from the financial institutions and reduce administrative fees.

In a May 11, 1983 report on lump-sum drawdowns, HUD's IG said the Federal Government was incurring substantial costs in order for grantees to earn program income. Furthermore, the Grace Commission report recommended that this type of drawdown be closely monitored and that Field staff be trained to determine if the funds are being used so as to obtain maximum leverage.

I understand you have submitted a proposal to OMB to eliminate the lump-sum provision.

Question: What is the status of the proposal submitted to OMB?

Answer: The Administration has proposed legislation to eliminate the lump sum draw down provision. This proposal was forwarded to Congress in February 1984.

Question: What actions will HUD take while the proposal is being studied to overcome the weaknesses in personnel and procedures?

Answer: The Department has revised the lump sum drawdown regulations which will shortly be placed in Departmental clearance. The proposed revision to the regulations will provide tighter regulatory controls on the use of the lump sum provision. In the interim, we have revised the Community Planning and Development Monitoring Handbook, 6509.2 REV 3 to give Field staff better guidance in monitoring lump sum agreements. By memorandum from Assistant Secretary Bollinger, dated February 13, 1984, we have required that Field Offices maintain a log of all current lump sum drawdown agreements. The Grantee Performance Report, to be completed by all CDBG grantees, has also been revised and implemented to include the current financial status of all accounts established through the use of lump sum agreements.

Question: What accounting and management controls has HUD instituted to monitor lump-sum funding?

Answer: Guidance and instructions to HUD Field Offices provide accounting and management controls short of those proposed in the revised draft regulation. Among those requirements proposed in the regulation are:

(1) upon execution of a lump sum agreement, a copy must be provided to the HUD Field Office for use in monitoring;

(2) requiring recipients to review and compare, on a yearly basis, program activity accomplished under the lump sum agreement with that anticipated,

(3) establishment by HUD of a minimum interest rate to be paid by the private financial institution in addition to another benefit, and

(4) a provision which precludes a grantee from entering into a new agreement or extending an existing agreement during any period of time in which an audit disallowance on a previous lump sum drawdown agreement remains unresolved.

Question: How will HUD ensure compliance with the 180-day legislative requirement in the 1983 Housing Act?

Answer. This requirement is incorporated in the proposed draft regulation.

TERMINATION OF COMMUNITY PLANNING AND DEVELOPMENT PROGRAMS

Question: Why does the Administration propose to terminate the Section 108 Loan Guarantee Program?

Answer: The Administration proposes to terminate the Section 108 Loan Guarantee program in order to alleviate pressures caused by excessive Federal borrowing. This proposal is consistent with other Administration initiatives to reduce the number and size of Federal credit programs. Moreover, the Administration does not believe that Section 108 is critical to the success of the CDBG program.

Question. How much was obligated in FY 1983 under Section 108?

Answer: Loan guarantee commitments totalled $60,626,592 for 22 projects in FY 1983.

Question: What is your expectation for FY 1985?

Answer: The Section 108 program will be discontinued at the end of FY 1984. No additional Loan Guarantee commitments are proposed for FY 1985. The Administration anticipates the Congress will agree to terminate the program.

Question: Why is the Section 312 Rehabilitation Loan Program proposed for termination?

Answer: Funds for housing rehabilitation continue to be available through the Community Development Block Grant program. In addition, the Rental Rehabilitation Grant program has now been enacted into law and will be available to assist communities beginning in 1984.

Question: How many loans would be available through each program if they were maintained at the FY 1984 levels, with the Section 312 program continued as a revolving fund?

Answer: It is currently estimated that $75.8 million would be available for Section 312 loans in 1985, if the program was not discontinued. These funds would come from loan repayments and recoveries of prior year commitments and would permit approval of approximately 2,740 loans. The FY 1984 funding level is estimated to be $132.0 million, and it is estimated that approximately 4,800 loans could be approved. For the Section 108 program, a program level of $225 million would enable approximately 60 loan guarantee commitments.

Question: How many units might be rehabilitated under Section 312 during FY 1985?

Answer: If $132.0 million were available for loans in FY 1985, approximately 9,000 units would be rehabilitated, a $75.8 million program level would permit 5,000 units to be rehabilitated.

UDAG FORMULA

Question: Do you believe that the UDAG formula discriminates against newer communities, especially those in the sunbelt due to emphasis on pre-1940 housing?

Answer: The UDAG selection system contains the following three criteria, as required by statute and regulations. Section 119(d)(1) of the Housing and Community Development Act of 1974, as amended, requires that the relative degree of economic distress (impaction) be the primary criterion for selection. The selection system gives this 40 of 100 points. Impaction is measured by population growth lag, poverty and the age of housing. Age of housing is defined in the Act as housing units constructed prior to 1940. Regulations issued in 1978 as well as subsequent regulations provide 0.5 weight for pre-1940 housing, 0.3 for poverty and 0.2 for population growth, paralleling, incidentially, the weights in the second CDBG allocation formula.

A second statutory criterion for selection is the comparative degree of economic deterioration (distress). This criterion is given 30 of 100 points and includes unemployment rate, change in per capita income, and job growth lag elements (for Small Cities, job growth lag is unavailable and not used).

The third criterion, also 30 points, is comprised of a number of elements related specifically to the proposed development itself.

Of these criteria, two elements may tend to work against newer, growing communities such as may be found in the sunbelt: age of housing and population growth-lag, both, incidentally, mandated for use for large cities by the statute. Other criteria or elements are neutral with regard to newer, growing communities, or may tend to favor the sunbelt regions, such as poverty.

The important question is how all of these elements work together to respond to the different forms that urban economic distress can take across the country, rather than their responsiveness to individual regions alone. There have been numerous questions raised recently concerning the appropriateness of pre-1940 housing as an indicator of such distress. Even among large cities, where pre-1940 housing is a proxy for the severe problems of older central cities, it is not always as reliable an indicator of Small City distress as it is of large city distress. HUD consequently is currently re-examining the usefulness of the pre-1940 housing variable in both large cities and small cities.

Question: Are you re-examining the weight given to the pre-1940 housing factor?

Answer: Yes. As noted above, HUD is re-evaluating the usefulness of pre-1940 housing in both large cities and small cities. We think that its usefulness as an indicator of city distress will differ between those types of cities. At this time, we believe that pre-1940 housing is still an appropriate factor for the UDAG selection system but we are concerned about the weight of pre-1940 housing in establishing the selection system, particularly for small cities. There is a task force working on how to improve the selection system and recommendations will be included in proposed regulations we expect to be published in the next few months.

UDAG - SMALL CITIES

Question: The participation of small cities in the UDAG program has been a problem in the past. How has the Department assisted smaller communities to participate in the UDAG program?

Answer: In the past many small cities were not able to make use of the Urban Development Action Grant (UDAG) program. Frequently development opportunities existed in small cities but they did not have the technical capabilities to package the projects to meet all application requirements.

To address this problem, the Department has provided increased outreach and technical assistance to small cities. This assistance has been provided both by HUD staff and by consultants funded through the Secretary's Discretionary Fund. This technical assistance has enabled many small cities to improve the quality of their UDAG applications. At the same time, the improved economic conditions, i.e. lower interest rates, have assisted small cities to submit applications based on firm private commitments, a prerequisite for receiving UDAG funding.

Question: What has been the record over the last several years?

Answer: The increase in small cities' participation in the UDAG program is shown in the following announcement data:

Senator Garn—Continued

Fiscal Year	Small Cities Announcement (Dollars in Millions)
1982 (actual)	$66.2
1983 (actual)	170.3
1984 (estimate)	235.7

Because of increased fundable applications, the funds set aside for small cities are no longer expected to be carried over from one year to the next. To the contrary, this fiscal year we expect the fundable applications from small cities to exceed the funds available.

UDAG - CARRYOVERS

Question: What are the estimated unobligated carryover balances as of the end of FY 83 - 85?

Answer: The following table shows the FY 83 - 85 actual and the current estimated unobligated carryover balances for the UDAG program.

	ACTUAL 1983	ESTIMATE 1984	ESTIMATE 1985
	(Dollars in Thousands)		
Unobligated carryover balances......	$380,451	$25,000	$75,000

Question: What are the reasons for these carryover balances?

Answer: The 1983 carryover amount was higher than originally estimated. This was primarily the result of the timing of the availability of funds proposed for deferral but which Congress directed be made available. Consequently, more than half of the project announcements occurred during the last half of the fiscal year. For example, $254.1 million, or 34.5 percent of total 1983 announcements, occurred in the last two monts of fiscal year 1983. Most of these announcements were carried over at the end of the fiscal year as unobligated announcements.

The 1984 carryover estimate of $25 million is a minimal amount which assumes virtually all 1984 announcements will reach the obligation stage. This estimate is changed from the $100 million estimate contained in the 1985 Budget. The revision reflects actual program activity thus far in 1984 and the anticipated delay of the September, 1984, large city announcement round to October, 1984.

The 1985 carryover of $75 million assumes that the September, 1985, large city announcement round will essentially result in obligations during the 1st quarter of fiscal 1986.

Question: What is the distribution of carryover for the large and for the small cities portion of the program?

Answer: The 1983 unobligated carryover amount was distributed as follows:

Large Cities....................	$247.1 million
Small Cities....................	133.3 million
	380.4 million

Question: Why was there such a high level of recaptured UDAG funds in 1983?

Answer: Prior year's experience indicates that approximately ten percent of the UDAG funds have been recaptured from projects being terminated. UDAG projects are approved in distressed cities to implement complex development deals and unforeseen events may occur. Not only can circumstances of the individual project change, but also development deals have been affected by the adverse economic conditions of the recent recession.

Last year, $135 million was recaptured. This amount was larger than usual due to several large projects being terminated as a result of adverse economic conditions.

URBAN HOMESTEADING PROGRAM

Question: What is the extent of participation by VA and FmHA?

Answer. The VA and FmHA are participating in the Urban Homesteading program to the extent that they are making properties available for transfer and use in the program upon request. As of September 30, 1983, 79 VA properties have been transferred under the Urban Homesteading program. No FmHA properties have been used under the program.

Question: How many of the 75 FmHA and 150 VA properties expected to be transferred in FY 1984 have been transferred to date?

Answer. As of March 31, 1984, none of the FmHA properties have been transferred as anticipated, but 52 VA properties have been transferred.

RENTAL REHABILITATION GRANTS

On November 30, 1983, Congress passed P.L. 98-181 which established new rental development and rehabilitation grant programs. The legislation authorized two distinct programs--a rental development grants program and rental rehabilitation grants program.

Question: What is the extent of Federal technical assistance that the Department anticipates will be needed to help communities design, implement and evaluate these programs?

Answer: The Department does not have an estimate of federal funds needed for technical assistance purposes by communities who will participate in the Rental Rehabilitation Grants or Rental Housing Development programs.

However, communities have already received assistance to administer their Rental Rehabilitation Grants program through their participation in the CDBG Rental Rehabilitation Demonstration. Through this Demonstration, States and local governments have gained capacity to perform rental rehabilitation tasks.

In pending appropriation language, there will be authorized the use of up to $2 million (over 2-year period), at the Secretary's discretion, for technical assistance purposes in the Rental Rehabilitation program. This $2 million would come from the $300 million total requested for the program.

Additionally, the Department believes that funds from the Secretary's Discretionary Fund under section 107 of the Housing and Community Development Act of 1974, as amended, may be used to provide technical assistance for Rental Rehabilitation programs supported with Block Grant funds.

Question: How much is included in your FY 1985 budget for technical assistance in conjunction with these programs?

Answer: The 1985 Budget proposes supplemental appropriation language for fiscal year 1984 to provide up to $1 million a year, from the Rental Rehabilitation Grants appropriation, which may be used for technical assistance. While no use of these funds for technical assistance is reflected in the Budget, the flexibility to use the funds, if necessary, would be there. There are no funds requested for technical assistance in conjunction with the Rental Housing Development program.

Question: Will there be any limits and/or controls established on the type and amount of rehabilitation assistance allowed on a given project to ensure that only substandard conditions are brought up to code at the minimum cost feasible?

Answer: The Rental Rehabilitation program contains several provisions which limit the cost of rehabilitation and type of repairs which are made:

1. Projects must be located in lower-income neighborhoods; these are areas where market or "street" rents are low; the marketplace and the limited rents thus limit the level of repairs which can be sustained.

2. In addition to the market constraints, the statute imposes a $5,000 per dwelling unit subsidy limit and limits subsidies to no more than 50 percent of rehabilitation costs with adjustments permitted for high cost areas.

3. Rehabilitation is limited by statute to those items necessary to correct substandard conditions, repair major systems in danger of failure, and make essential improvements.

The Housing Development Grant program draft regulations contain several features which relate to limitations on the degree of substantial rehabilitation for a project. Projects must be located in areas designated to be experiencing a severe shortage of decent rental housing opportunities for families and individuals without other reasonable and affordable housing alternatives in the private market or projects must meet special purpose housing needs. In addition, a minimum of 20% of the units in a project must be lower-income housing. The market area and the lower-income housing requirement would serve to keep rents at a minimum and therefore the costs of the substantial rehabilitation activity to a minimum. In addition, the value of the project is not to exceed Section 207 (insured) statutory per unit limitations for units of modest design. The financial feasibility of the project is also reviewed by HUD which would ensure that the degree of rehabilitation would be feasible and supportable by reasonable rent. The amount of the grant is not to exceed 50% of the total cost of the project. The Department and the applicant sign a legally binding grant agreement which specifies the terms and conditions under which grant funds are to be provided. The grant constitutes a debt to the owner, repayable in the event of substantial violations.

Question: Will project owners be required to pass on to the tenants the reduction in costs resulting from the rehabilitation assistance provided?

Answer: Under the Rental Rehabilitation Grants program, the benefit to the tenants is that without the subsidy, the unit would not be affordable at all as a decent unit. Thus, project owners will be passing on to tenants the benefits they enjoy as program participants.

The Housing Development Grant program will assure that affordable rental housing will be provided through the selection process and project management. The application submission requires the grantees to indicate the extent to which units will be maintained with rents at levels proposed. The owner is also required to maintain a minimum of 20% of the units for lower income families. Priorities of selection are assigned to those projects where more than 20% of the units are assisted. During the selection process, the Department will review the rent mechanism and the extent to which the grantee assures rents will be affordable to lower income families and very low-income families. Therefore, through the competitive selection process, the Department can assure that rents will be maintained at reasonable levels for lower income and very low-income families. Once the project is under management, maximum rent schedules for lower-income units will be proposed by the owner based on size and reviewed and approved by the grantee subject to revision as the Department's various adjustment bases warrant.

Question: How will projects that are funded through the Rental Rehabilitation Grants program be targeted to low-income families and will there be assurances that the rehabilitated units will remain available to low-income families for an extended period of time?

Answer: The Rental Rehabilitation program is targeted to lower-income families. There are several key provisions of the statute in this respect:

1. Between 100 percent and 70 percent of the funds must be used to benefit lower-income families. This requirement is met when there is actual initial occupancy by lower-income families in units assisted with program funds.

2. All rehabilitation must take place in lower-income neighborhoods where rents are affordable (i.e.,) within applicable Section 8 FMRs) and are likely to remain affordable for at least five (5) years.

3. Adjustment are made to grantee funding where units have not remained affordable to lower-income families.

Question: How many of the 60,000 rental rehabilitation units will require vouchers and how many of the 16,000 development units might require vouchers?

Answer: Because of the targeting of the Rental Rehabilitation program to lower-income families and projects in lower-income neighborhoods it is likely that a significant number of assisted units will be occupied by families eligible for voucher assistance and requiring this rental subsidy to help pay the rent. However, there are some lower-income families, particularly those between 65 percent and 80 percent of median income who will occupy Rental Rehabilitation units but will not need assistance to be able to afford the after-rehabilitation rents. The exact proportion of tenants requiring assistance and those needing none will not be known until we have actual experience with the program. At this time we do not contemplate the use of vouchers in the Rental Housing Development Grants program.

Question: Does the Department intend to continue with the Rental Rehabilitation Program Demonstration it started during FY 1981?

Answer: The third and final round of the Demonstration was announced in early June of this year.

Question: I understand that, based on the Demonstration Program, you now estimate that the average per unit cost may be less than $5,000. What is your best guess estimate at this time and what does this translate into relative to the number of units assisted?

Answer: Our experience in the Demonstration indicates that subsidy costs per unit are approximately $3,500 per unit. It is difficult to predict the effect of various Rental Rehabilitation program requirements on costs and it is possible that these additional requirements that were not part of the Demonstration may increase subsidy costs. In addition, the formula allocations provide proportionately more money to larger cities which often have higher rehabilitation costs. Average costs in the program could be higher than in the Demonstration. Until we have some experience with Rental Rehabilitation, the Budget continues to estimate an average per unit cost of no more than $5,000 and this will support the rehabilitation of at least 60,000 units over a two-year period.

Question: In any event, I understand that you do not expect to provide more than 60,000 vouchers for this program no matter how many units receive grants--is that true?

Answer: We believe that 60,000 vouchers is an appropriate number of vouchers and/or certificates to be used in conjunction with the Rental Rehabilitation program.

Question: What steps are the Department taking to evaluate the Demonstration?

Answer: CPD's Office of Evaluation has recently completed an in-depth evaluation of the first 18 month's experience in the Demonstration. Extensive interviews with program participants, administrators, and others (contractors, private lenders, etc.) coupled with numerous site visits and program data will provide a complete assessment of the Demonstration to date. The report of that evaluation will be released shortly. On a continuing basis, the Department collects pertinent information on each property rehabiltiated in the Demonstration. For each property, the following information is collected:

1. Location and ownership characteristics;
2. Property characteristics before and after rehabilitation;
3. Financial structure of project; and
4. Tenant characteristics before rehabilitation and characteristics of tenants moving into the building after rehabilitation.

The information is collected within 45 days after construction has been completed for each project and is tabulated monthly.

Question: What percent of the units might receive exceptions to the $5,000 limit?

Answer: It is premature and thus impossible to predict what percentage of units will require subsidies greater than the $5,000 limit. The Department will assure that every appropriate step is taken by the grantee to work within the $5,000 per unit limit.

Question: Does HUD plan to monitor the new program to determine if it actually increases a community's rental rehabilitation activities other than substituting for CDBG funds?

Answer: Yes, the Department will monitor this new program. While there is always the possibility of substitution when a new, highly targeted program is initiated, the amount of substitution of Rental Rehabilitation funds for CDBG rental rehabilitation activities is expected to be small. This is because very little CDBG money has been used to rehabilitate rental housing, other than in connection with the Demonstration.

ENTERPRISE ZONES

Question: If an Enterprise Zone Act is passed, what safeguards does HUD believe are needed to limit Federal revenue losses?

Answer: The tax incentives provided under the Act will result in the loss of some Federal revenue. To limit losses to the Treasury resulting from use of Enterprise Zone tax incentives, the Administration has included provisions for "minimizing unnecessary tax losses to the Federal Government" as a major factor which must be considered in selecting nominated areas for

Enterprise Zone designation. For example, a Zone gerrymandered to include an existing, profitable business could be rejected on this ground.

Question: Would program costs be offset by newly-generated revenues or reduced government expenditures, and, if so, to what extent?

Answer: It is not possible to estimate the net cost of Enterprise Zones offsetting revenues. However we believe that cost reductions undoubtedly will be significant. Two of the areas which affect the net cost are (1) the reduction in Federal Government expenditures for welfare, AFDC, food stamps, unemployment compensation, and supporting social service programs as unemployed persons are hired in Enterprise Zones, and (2) the increased revenues from taxes paid by Enterprise Zone businesses that become more profitable and by individuals who receive new jobs and begin to once again earn an income. Offsetting revenues and cost reductions should also be realized by participating State and local governments as previously tax-delinquent properties again become revenue producers.

Question: What is the estimated cost of an Enterprise Zone program over its expected life?

Answer: The Treasury Department has not been able to do a cost projection for the entire 24 years for which Enterprise Zones would be authorized. However, in the short term, the Treasury Department has made the following gross estimates of revenue loss: in FY 1985 the revenue loss would be $98 million, since tax incentives would affect taxable years beginning after January 1, 1985; in FY 1986 it has been estimated at $420 million, $775 million in 1987, $1,017 million in 1988, and $1,051 million in 1989. These estimates are based on the assumption that the increased business activity would have occurred in any event elsewhere. The total cost of the program increases during these years as the number of zones and the pace of activity in them increases. The estimates do not reflect costs offset by secondary and tertiary benefits which will result, such as reduction of welfare and unemployment costs, new tax revenues, enhanced local tax bases, and other economic ripple effects.

Question: Last year, I asked you about your plans to evaluate the experience of various Enterprise Zones once they are established. You assured me that an evaluation plan was being drafted. What is the current status of your evaluation plans?

Answer: We developed an initial evaluation plan for Enterprise Zones which we shared with the Committee staff last year. Currently, we are revising that plan to incorporate what we learn from State and local Enterprise Zones and to clarify the types of employment analysis that will be possible.

Question: Please submit this plan for the record.

Answer: A revised evaluation plan should be ready by July 30, 1984, and we will be glad to submit it at that time.

RESEARCH AND TECHNOLOGY

Question: After subtracting the $4 million for the Public Housing Study, the "Net" amount remaining available for research in 1984 is $15 million. This is considerably less than the $20.9 million proposed for 1985. What is the basis for this large increase in 1985?

Answer: The "net" appropriation level of $15 million was the lowest funding level for PD&R since its first two years of operation over 15 years ago. Of the amount requested, $13.2 million is needed for the American Housing Survey and ongoing housing research. If a $15 million funding level were maintained for 1985, it would leave only $1.8 million on discretionary funds for new projects.

The $20.9 million funding level in 1985 provides the needed funds required to undertake the following research efforts that would not be possible at the $15 million level: implementation of many evaluations called for by the Housing and Urban-Rural Recovery Act of 1983--Rental Rehabilitation, Rental Housing Development Grants, Reinsurance demonstration , Public Housing Childcare demostration, Multifamily and locally-owned Homesteading demonstrations, and the "McKinney" demonstration.

Question: What is the status of $2 million PHA Management Study authorized by the 1983 Housing Act?

Answer: This Administration has shown consistent interest in public housing management concerns. Section 466 directed that not less than $2 million of the 1984 appropriation be provided for research on PHA management problems, and HUD plans to use over $2.3 million of 1984 R&T funds on issues related to PHA management.

Question: How much have you budgeted for the American Housing Survey in FY 1985 and how does this compare to the FY 1983 and FY 1984 levels?

Answer: The estimated obligation for the American Housing Survey (AHS) is $10.0 million in 1985 as compared to $10.6 million in 1983 and an estimated $7.3 million in 1984. The difference in the 1984 and 1985 estimates is because the Department has flexibility in obligating funds for the AHS, by source year, due to the annual work effort overlapping two fiscal years. That is, the annual agreement with the Census Bureau begins in one fiscal year and ends the next. Therefore, the Department is not required to fund the full contract in the first year, but, instead, can split the funding equally between the two affected years. This has been the normal practice. However, to accommodate the high demand for funding in 1984 due to other priorities, the Department intends to fund a smaller portion of the 1984/1985 AHS from 1984 funds and a larger portion with 1985 funds. The result, of course, will be that a higher amount is necessary in 1985 than would normally be the case.

HUD LEAD-BASED PAINT POISONING PREVENTION ACT OF 1971

Question: What is HUD doing to revise the lead-based paint regulations in view of the recent Federal Court decision (Ashton V. Pierce)?

Answer: Ashton v. Pierce ordered HUD to reopen rulemaking to address immediate hazards related to intact lead-painted surfaces and the extent of monitoring and enforcement with regard to the elimination of lead-based paint hazards in public housing. HUD regulations defined immediate hazards in terms of defective (e.g., crashing, scaling, chipping, peeling or loose) paint. Painted surfaces not in defective condition are described as "intact or tight". The court held that, as a matter of law, intact lead-painted surfaces were immediate hazards. As a result, HUD is proceeding with this rulemaking in order to obtain a sound factual basis for amending the regulations consistent with the court decision.

Question: How much is being reserved from the FY 1984 CIAP funds for lead-based paint?

Answer: Approximately $71 million of budget authority is being reserved for lead-based paint removal from FY 1984 CIAP funds. This will support an estimated $35 million of loans for paint removal purposes.

Question: When do you plan to allocate these funds to the PHAs and what criteria do you intend to use to allocate these funds?

Answer: Procedures for allocating funds were established by PIH Notice 84-6, dated April 23, 1984. The schedule established in this notice requires that funds be reserved by September 30, 1984. Funding priority for allocating funds will be given in the following order:

a. Units with defective lead-based paint or lead-based paint code violations which house a child that has a confirmed elevated blood lead level.

b. Common areas or accessible exterior surfaces with defective lead-based paint or lead-based paint code violations in the same buildings which have units in subparagraph a.

c. Units with defective lead-based or lead-based paint code violations which house a child under seven years of age.

d. Common areas or accessible exterior surfaces with defective lead-based paint or lead-based paint code violations in the same buildings which have units in subparagraph c, and meet a prescribed sampling test.

e. Other units, with defective lead-based paint or lead-based paint code violations in the same buildings which have units in subparagraphs a or c.

f. Other family units, common areas or accessible exterior surfaces, with defective lead-based paint or lead-based paint code violations, in other buildings in the same project which have units in subparagraphs a or c and in projects which do not have units in subparagraphs a through e.

HOUSING ASSISTANCE COUNCIL (HAC)

In FY 1984, we directed that funding for HAC be made available through your S&E account in contrast to previous practice where they were funded in PD&R.

Question: How has this new arrangement worked out?

Answer: We have experienced no significant problems with regard to providing financial assistance to HAC under this new arrangement.

Question: What activities is HAC undertaking in FY 1984 that will be of assistance to the Department in serving the housing needs of rural America?

Answer: Some of the reports to be prepared by HAC in FY 1984 can assist the Department in serving people in rural areas. For example, the report on the status of public housing in rural areas should provide some insight as to reasons for variations in subsidy costs and management problems. In addition, the Department is continuing to look for ways to increase HUD program accessibility in rural areas. HAC reports on mortgage credit availability, use of inventory stock, and alternative housing standards may prove useful in this regard.

Question: Why didn't you include any funding for HAC in your FY 1985 Budget?

Answer: The Department does not believe it appropriate to include specific set asides, in either the Research and Technology or Salaries and Expenses accounts, to meet the on-going operational costs of any group.

Question: Did you request funding for HAC in you OMB submission?

Answer: No funding was requested for HAC in 1985.

FAIR HOUSING

During his 1983 State of the Union Address, the President referred to the issue of civil rights and stated, "Effective enforcement of our Nation's fair housing laws is also essential to ensuring equal opportunity. In the year ahead, we will work to strengthen enforcement of fair housing laws for all Americans."

Question: What do you intend to do during FY 85 to fulfill this commitment?

Answer: Pursuant to the President's directive, as outlined in his State of the Union Address, the Department developed and submitted to Congress, on July 12, 1983, proposed legislation which would strengthen the current Federal Fair Housing Law (Title VIII of the Civil Rights Act of 1968, as amended). This legislation would serve as a model for State and local governments which have passed fair housing laws and ordinances.

Since its formal submission, the President and Department have pressed for the passage of this important legislation and are confident the Congress will act upon the Administration's proposed legislation this fiscal year.

For FY 1985 you are requesting $6.7 million for your Fair Housing Assistance Program.

Question: What level of funding did you request from OMB?

Answer: Our initial request, to OMB, for the Fair Housing Assistance Program was $6.0 million. However, subsequent to the budget submission, the Department and OMB agreed that it would be more appropriate to increase the funding level from $6.0 million to $6.7 million. Not only are new agencies anticipated to enter the program but the complaint activity of second, third and fourth year participants is estimated to increase. Additional funds are therefore needed to adequately reimburse older participating agencies and maintain sufficient funds to build the capacity of new agencies entering the program.

Question: How do you account for the fact that you requested $5.7 million in FY 1983, $6.7 million in FY 85 and only $4.7 million in FY 1984--what was the programmatic reason for the FY 1984 decrease?

Answer: The decrease in FY 1984 -- as compared to FY 1983 -- reflected a decrease of $1.0 million for the Community Housing Resource Boards (CHRB) component of the Fair Housing Assistance Program. At the time the FY 1984 Budget proposal was formulated, we were experiencing administrative delays relative to the obligation of funds--large carryover balances were projected to be available at the end of fiscal year 1983. Therefore, we felt that a reduced level of funding should be provided until all unobligated balances were utilized. We also wanted to begin to evaluate the program during its initial stages of operation.

Now that all administrative mechanisms are in place and preliminary results indicate that substantial benefits are derived from the program, we believe that the original level of funding should be resumed.

Question: Your justification indicates that you expect to be able to support 130 Community Housing Resource Boards during FY 84 and 100 during FY 85. Why this decrease -- what is the "optimal" number?

Answer: The Department's appropriation act provided $1.0 million in 1984. However, $1.6 million was carried over from the 1983 appropriation. Community Housing Resource Boards (CHRBs) receive $15,000-$25,000 each; therefore it is currently estimated that the total of $2.6 million will provide support for 130 CHRBs. The budget request of $2.0 million in 1985 does not anticipate the carryover of unobligated balances. Therefore, the budget request will provide support for approximately 100 CHRBs.

There are currently 589 CHRBs in existence and it is estimated that an additional 50 will be established in fiscal years 1984 and 1985. The Department has not established an "optimal" number of CHRBs to support. We are closely monitoring the accomplishments of CHRBs and while data indicate that funded CHRBs are more viable entities, each year we will make an assessment of funding needs in this area before developing estimates of the number of CHRBs to support.

EMPLOYMENT

Question: Your FY 1985 request shows a reduction of 1,369 FTEs. Please summarize the reduction by program. Will a reduction-in-force (RIF) be required to achieve the proposed staff reduction?

Answer: The reduction of 1,369.1 full-time equivalent (FTE) work-years from the actual 1983 level to the estimate for 1985 is distributed by program area as follows:

Housing	-548.9
Public and Indian Housing	-277.6
Government National Mortgage Association	-.4
Solar Energy and Energy Conservation Bank	-.6
Community Planning and Development	-118.6
New Community Development Corporation	-32.6
Policy Development and Research	-3.5
Fair Housing and Equal Opportunity	+32.9
General Management and Administration	-419.8
Total	-1,369.1

It is not anticipated that a reduction in force (RIF) will be required to achieve these reductions.

EXPERTS AND CONSULTANTS

Question: How much do you have in your FY 1985 budget for experts and consultants?

Answer: In our FY 1985 budget we have $380,000 for direct hires of experts and consultants. More details are included on page H-21, Part 3 of the 1985 Congressional Justification.

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HUD TRAVEL BY BUDGET ACTIVITY

Question: Please submit for the record, a comparison of your FY 1984 and FY 1985 travel budget for both the field and headquarters offices. Also include a breakdown of the major HUD programs.

Answer: The funding level established for the field in the budget request is formulated on the basis of national requirements for each budget activity rather than on the basis of individual programs or geographical location. The distribution of funds among the Regions is made during the execution phase and is based upon total requirements for all activities. The following table indicates the distribution of FY 1984 funds and our estimate of how the level of funds proposed for FY 1985 will be distributed.

	Estimate FY 1984 (Dollars in Thousands)	Estimate FY 1985 (Dollars in Thousands)
Housing Program	$4,836	$4,796
Public and Indian Housing	925	923
Government National Mortgage Association	36	36
Solar Energy and Energy Conservation Bank	20	20
Community Planning and Development	1,270	1,286
Policy Development and Research	108	108
Fair Housing and Equal Opportunity	826	850
Departmental Management	387	387
Office of General Counsel	202	202
Field Legal Services	122	122
Office of Inspector General	1,667	1,667
Administration and Staff Services	278	275
Training Travel	1,300	1,300
Field Direction and Operational Support	775	770
Field Administration	498	458
Total	13,250	13,200

Recapitulation

	Estimate FY 1984	Estimate FY 1985
Headquarters	5,239	N/A
Field	8,011	N/A
Total	13,250	13,200

SKILLS ANALYSIS

Question: What is the status of HUD's "Pilot Staffing Analysis" in the housing area to determine what skills are needed in field offices?

Answer: A contract was awarded for the conduct of a Housing Skills Analysis, and the contractor has completed Phase I of a three-phase study. Selected Housing programs staff were interviewed to determine anticipated program and policy directions for the next three to five years and to project skills commensurate with the changes.

Phase II of the project is in progress. A skills survey is being made of all Housing staff in the Field Offices. The purpose of this task is to develop an inventory of skills available among current Housing staff.

Phase III will begin when Phase II is completed. The contractor will analyze the data obtained in the previous phases and make recommendations for workforce planning.

Question: Do you plan to perform this type of analysis in all HUD program areas?

Answer: Decisions on analysis in other program areas will depend on the outcome of the Housing study.

Question: Is this a one-time effort or part of management's ongoing responsibility to continually evaluate and improve Field Office program delivery skills?

Answer: It is part of management's ongoing responsibility to evaluate and improve field program delivery skills.

STAFF TRAINING

Question: Is HUD planning to develop a formal training assessment program to determine if present training programs are appropriate and effective?

Answer: HUD annually assesses both the training needs of its employees and the system used to determine those needs. The results of the needs assessment process are incorporated in a training plan which relates training needs to Departmental goals and objectives and to available resources.

HUD also requires an evaluation of training. Evaluations range in scope from a minimum of budget and population data to more comprehensive evaluations involving classroom and other testing instruments and analysis of the organizational impact of training.

Question: How much have you included in your FY 85 Budget for staff training and how does this compare to the FY 83 and FY 84 levels?

Answer: The table below identifies the funds included for staff training in the Department's 1985 budget request. They consist of the funds directly administered by the Office of Training at Headquarters and those issued to the various Regions who administer them with technical guidance from the Office of Training.

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	ACTUAL 1983	ESTIMATE 1984	ESTIMATE 1985	INCREASE + DECREASE - 1985 vs 1984
Travel	$1,284	$1,300	$1,300	...
Rental of Training Facilities	57	75	100	+$25
Printing	74	80	80	...
Enrollments	872	850	850	...
Contracts	1,238	1,400	1,450	+50
Supplies	157	160	160	...
Equipment	7	10	10	...
Total	3,689	3,875	3,950	+75

AUTOMATED MANAGEMENT SYSTEMS

Question: The cost to the Federal Government from the failure of insured projects is tremendous, particularly if HUD ultimately has to acquire and dispose of the projects.

Last year, the staff reviewed your automated property management systems. Although the data contained in the system, and its instant availability, is impressive, the true test of the system will be the extent to which it reduces costs and improves your management.

I am concerned that these systems contain criteria to alert the staff to upcoming problems.

What specific "flags" have you built into these systems since last year?

Answer: During FY 1984, a number of additional flags were built into the Multifamily Project Management System to alert Field Office staff to problems or potential problems with collections, delinquencies, budget, subsidies, and taxes. Specifically:

-- A Project-At-A-Glance report which highlights on one page a few items for the staff to focus on. It shows occupancy, collections, and delinquencies, with percentage changes from the previous month. It also provides a financial summary (fiscal year to date, previous month, and current month) with a comparison of actual expenditures to budget amounts and expense per unit per month. With this one page staff can determine whether a project is losing occupants, behind on collections, overspending its budget, or is otherwise in trouble.

-- A funds control report which allows Headquarters staff to monitor expenditures by project. It rolls up each project and compares expenditures to budget amounts. When a project is in danger of exceeding its budget, a "DANGER" note appears in the margin to alert staff to take appropriate action.

-- Various project occupancy reports (by month and summary) which alert staff to projects with declining occupancy, a sign of potential problems.

- -- A subsidy report which identifies each subsidy paid to a project and the amount. It supports the staff in their efforts to ensure that HUD is not paying double subsidies on a project.

- -- An Aged Tenant Receivables report which tracks collections and shows projects with problems and how far behind they are.

- -- Tax reports which ensure that HUD doesn't lose projects because taxes aren't paid by alerting staff to the tax due dates and appeal dates. One report shows changes in assessments so that those which are excessive can be challenged.

Question: What is the total expected cost and completion dates for the development of each of these systems?

Answer: There will be five automated subsystems associated with the insurance and management of multifamily projects. The following table lists them and the actual or anticipated completion dates for the development of the systems:

Multifamily Property Management - August 1983
Multifamily Notes Servicing - August 1984
Multifamily Underwriting - December 1984
Multifamily Premium Billing - December 1984
Multifamily Claims - December 1984

Full cost data are not yet available for each system, but we have done cost/benefit comparisons on two of the systems for which sufficient data are available to develop a model. The costs/benefits based on a seven-year life cycle for those systems are:

	Benefits/Costs (Millions)	Ratio
Multifamily Property Management	22.2/13.7	1.6:1.0
Multifamily Notes Servicing	93.8/60.6	1.5:1.0

In the case of the Multifamily Property Management System, which was acquired during September 1982, there are more specific data available. This system is currently operational in all regions. The one-time cost to acquire the system, which included the programs and modifications and the training of 150 to 200 property managers and staff in 20 Area Offices, was $650,000. The operational cost is about $5.00 per unit per month for the 25,000 units under management, or about $1.5 million per year. An additional $30,000 is budgeted in FY 1984 for the development of training material to upgrade the analytical use of the system.

QUESTIONS SUBMITTED BY SENATOR D'AMATO

SECTION 202

Senator Heinz and myself have introduced S. 1648, a bill to revamp and expand the Section 202 program. Congressman Lundine has introduced similar legislation in the House. The bills would reduce the budget authority of the Section 202 program by revising the subsidy and financing mechanism to provide for interest free advances instead of loans and to provide fixed operating subsidies instead of Section 8 authority. Currently, budget authority for the program is bloated in that it reflects both the 202 loan amount and the 20 years of Section 8 payments which essentially repay the loans.

Our legislation would also make an additional 18,000 units available under a new supplemental program involving partial funding and administrative support from State Housing Agencies.

Question: What is your opinion of the success of the current 202 program?

Answer: The current Section 202 has been very successful. Since 1978, more than 100,000 units have been completed and made available for elderly or handicapped persons.

Question: Does it adequately address the needs of our elderly and handicapped or are revisions as proposed in the legislation I have outlined desirable?

Answer: The Department believes that the Section 202 program as currently structured, along with the Section 8 and Housing Voucher programs, adequately address the needs of the elderly or handicapped. The Department does have problems with the Heinz-Lundine Bill as follows:

a. The proposed legislation includes no real cost savings. In fact, on a per unit basis, the combined direct Federal costs and indirect Federal costs would match, and in many cases exceed those experienced under the existing program.

b. Participation by limited dividend sponsors would open the program to syndications and tax expenditures. The use of tax-exempt State Agency supported bonds for a portion of the project cost would result in additional tax expenditures. The tax expenditures, when added to direct subsidy costs (advances and operating subsidies), would increase costs over those under the existing program.

c. Entire development cost would be paid up-front from appropriated funds. Repayment of advances would begin, following the twentieth year, only if the project did not continue in use as housing for elderly and handicapped persons.

d. The Bill would substantially expand subsidized production activity with a corresponding increase in direct Federal subsidy costs. It would more than double the yearly number of units assisted and would expand income eligibility to include households in 50-80 percent of area median and above.

e. HUD does, however, favor initiating a review of all potential cost-effective changes to present Departmental programs and services offered to the elderly and handicapped.

SECTION 235

As you know, the Housing and Urban-Rural Recovery Act of 1983 revised and reauthorized the Section 235 Homeowners Assistance program providing for the use of repaid or recaptured funds, as well as newly appropriated funds. Your Budget does not include any request for funding of this program.

Question: Can you explain why?

Answer: It had been determined that in a tight budget, scarce resources should be devoted to providing rental assistance to those most in need of Federal subsidy (very low-income-families) rather than be used to subsidize homeownership. This subsidy assistance to homeowners is an inefficient and inequitable use of scare Federal resources.

Also, the Department's subsidized housing strategy for fiscal year 1985 emphasizes subsidies for existing housing. The Section 235 program is primarily a new construction program, with few substantially rehabilitated units.

In addition, the implementation of this restructured program could have an impact on Federal outlays as early as fiscal year 1984 or the beginning of 1985. We could not implement the program and restrict Federal outlays as we must.

Follow Up

The City of New York has found the Section 235 Mortgage Assistance Program to be an effective tool for stabilizing borderline communities by providing single family homes for working class families which otherwise would be priced out of the market. These families often form the backbone of communities and turn around a pattern of abandonment and further deterioration that would eventually cost Federal, State, and local governments much more to reverse.

Question: In this light, is the lack of a budget request for 235 funds penny wise, but dollar foolish?

Answer: The Department feels that a more equitable use of tax dollars is to help lower-income, truly needy families, in their quest for decent rental housing rather than to help the moderate- to middle-income families which the Section 235 program serves.

Senator D'Amato—Continued

RENTAL REHABILITATION GRANTS

Section 301 of the Housing and Urban-Rural Recovery Act authorizes the new Rental Rehabilitation Program with the explicit reservation of voucher assistance to those families that would otherwise be displaced by post-rehabilitation rents. However, a provision in Section 207 of Public Law 98-181, which seems to contravene the intent of Section 301, limits voucher assistance to only "very low-income" families (50 percent or below median). Apparently, the interim regulations for the Rental Rehabilitation Program strictly interpret this targeting provision, which, I am told, will lead to the displacement of many families in the 50 percent median to 80 percent income range.

This was obviously not the intent of the new program.

Question: Can HUD adjust the pending regulations to carry out the real intent of the Rental Rehabilitation Program to ensure that these families are not displaced?

Answer: Even though the Rental Rehabilitation Program is designed to provide standard housing for tenants with incomes below 80 percent of median, it is true that Section 207 of Public Law 98-181 does clearly limit voucher assistance to very low-income families. This may pose a problem since participating States and local governments will have to be selective in determining which properties to rehabilitate. While some lower-income tenants with incomes between 50 percent and 80 percent of median income will be able to pay rents after rehabilitation without any rental assistance, there are others who will not be able to do so and, as a result, would be displaced by the rehabilitation.

A study conducted by HUD's Office of Policy Development and Research shows that approximately 41 percent of families with incomes between 50 percent and 80 percent of median income can afford housing within the Fair Market Rents without rental assistance. Another 54 percent could afford units available for rent within FMRs without assistance if they paid between 30 percent and 37.5 percent of their income for rent. Those who cannot afford housing within the FMRs without paying more than 30 percent of their income to rent tend to be families with incomes between 50 percent and 65 percent of median income.

HUD is concerned about this problem but Section 207 of Public Law 98-181 does not allow vouchers to be used for other than very low-income families. Because of the statutory constraint, we cannot adjust the pending regulations.

Senator D'Amato—Continued

RENTAL REHABILITATION AND HOUSING DEVELOPMENT GRANTS

Section 303 of the Housing and Urban-Rural Recovery Act authorized the use of Section 223(f) mortgage coinsurance for Section 17 rehabilitation projects. I inserted this provision in the legislation in the early stages of its drafting with the intent of providing for greater leverage of the Federal dollar with private capital in these projects.

The interim regulations for the Rental Rehabilitation Program do not contain any provision for the use of 223(f) coinsurance. I understand that HUD intends to promulgate relevant regulations on this matter either as an addendum to the current rehabilitation regulations or as separate regulation in the near future.

Question: Can you confirm that intention and inform us as to when these 223(f) regulations will be effective?

Answer: The regulations implementing Section 17 have been divided into two distinct parts, the Rental Rehabilitation Program and the Housing Development Grants Program. HUD has included the implementation of the use of 223(f) coinsurance with the Housing Development Grants Program regulations.

The regulation has been submitted to OMB by the Department. As soon as OMB has cleared it, it will be submitted to Congress. We anticipate clearance in the near future.

Question: Can we be certain the regulations forthcoming for the Rental Housing Development Grant program will include a provision for 11(b) tax-exempt financing as mandated by Public Law 98-181?

Answer: Yes. Section 301 of the statute under which the Rental Housing Development Grant program was authorized--the Housing and Urban-Rural Recovery Act of 1983--specifically provides that tax-exempt financing be made available and Department regulations will be consistent with this legislative mandate.

QUESTIONS SUBMITTED BY SENATOR HUDDLESTON

1985 SPENDING FREEZE

Question: If funding for assisted housing is frozen in FY 1985 at the same dollar level as in fiscal year 1984, what implications would you see for your programs and how would you seek to allocate the funds?

Answer: From the perspective of the Section 8 program, the FY 1984 authority level is greater than the FY 1985 level by $52.4 million of contract authority and $4.0 billion of budget authority. This additional contract and budget authority is deemend to be unnecessary at a time when Federal spending levels should be carefully controlled. Therefore, the Department finds the amount requested in support of the proposed FY 1985 program level to be sufficient.

Question: If the fiscal 1985 assisted housing program was set programmatically (i.e., 5,000 new public housing units, 56,000 Section 8 existing, 14,000 Section 202, 15,000 vouchers and $1.5 billion for operating subsidies), what impact would you foresee?

Answer: The overall impact, from the Assisted Housing perspective, would be to provide approximately 3,500 net fewer unit reservations and at the same time require greater contract authority of $106.6 million and budget authority of almost $5.0 billion, primarily due to increased authority requirements for the additional Section 202 and Section 8 existing units. Also, the Section 202 program would require approximately $200 million more in loan authority to fund the additional 4,000 units.

Question: If HUD programs other than assisted housing are frozen at the fiscal 1984 level, what problems, if any, do you foresee?

Answer: As far as Housing is concerned, the result would be that the Temporary Mortgage Assistance Program would be able to assist 3,105 fewer homeowners if the program was frozen at the 1984 levels. Under the Troubled Projects (Flexible Subsidy) Program, a total of 77 additional projects could be assisted. Two additional sponsors of Section 202 projects would receive loans under the Nonprofit Sponsor Assistance Program and an additional 219 counseling agencies would be funded resulting in 58,000 more clients being counseled.

As far as the nonhousing programs are concerned, in most cases, the Department is already requesting the same levels of Budget Authority in FY 1985 as had been appropriated for FY 1984.

There are two programs however, for which reduction to the 1984 levels would cause problems. These include the Research and Technology account which would be decreased from $20.9 million to the FY 1984 level of $19.0 million, a reduction of $1.9 million and the Fair Housing Assistance program which would be decreased from $6.7 million to the FY 1984 level of $4.7 million, a reduction of $2.0 million. A reduction to the Research and Technology account would affect the Department's ability to meet its research responsibilities, including new requirements mandated by the Housing and Urban-Rural Recovery Act of 1983. A reduction to the Fair Housing Assistance program would affect the ability of the Department to fund new State and local agencies expected to participate in the program in 1985. A reduction would also prevent full funding of Community Housing Resource Boards in support of the voluntary compliance program.

SECTION 8

I understand that HUD is planning to reduce administrative fees in the Section 8 program from the current 8.5 percent of fair market rent to 6 percent.

Question: Is that correct?

Answer: Yes, the revised administrative fee system allows for an intake fee of $270 and an ongoing fee of 6 percent of the FMR per year on a national average.

Question: What is the justification for such a change?

Answer: The revised system is based on a study performed for HUD by the firm of Coopers and Lybrand which found the overall system to be adequate but that it tended to underfund those PHAs with high turnover rates and overfund those PHAs with low turnover rates. Under the old system, HUD paid an intake fee only once, when a certificate was first issued. Under the revised system, the intake fee compensates a PHA up to $270 for each newly allocated unit and for each certificate turnover, thereby absorbing some of the expense that was covered previously under the on-going administrative fee. For this reason, the on-going administrative fee is being lowered to 6 percent.

Question: What would the dollar impact be on local housing authorities?

Answer: The Department believes that these changes will result in a more equitable administrative fee system. Overall, many PHAs will experience little or no change in funding because of the revisions, but PHAs with high family turnover will receive more funding to cover their higher costs. The revised administrative fee system will have a "hold harmless" provision for those PHAs which would experience a decrease in their administrative fees. Under the hold-harmless provision these PHAs would receive the lesser of their former fee or the amount actually spent.

Question: Has this been discussed with any of the authorities?

Answer: Yes. This change was discussed with representatives from different housing authorities in several training sessions. The Department has also responded to many inquiries from housing authorities concerning the revision of the administrative fee system.

Question: I also understand that HUD plans to set a payment of $270 for tenant turnovers at the time of issuance of a new certificate of eligibility and that this fee will replace a current so-called preliminary fee of $275. What is the reason for this?

Senator Huddleston—Continued

Answer: Under the current administrative fee system, the PHA receives a preliminary fee for each newly allocated unit to cover the costs of taking new families into the program. For any certificate that turns over (i.e., when a family leaves the program and is replaced by a new family) the PHA must rely on its on-going administrative fee to cover the costs of what is essentially an intake function - the processing of new families. Thus, as a result of the study recommendations, the administrative fee system is being restructured to cover separately the costs of intake and on-going functions. The one-time preliminary fee of up to $275 per newly allocated unit is being replaced by an intake fee of up to $270 for each newly allocated unit and with each certificate turnover.

VOUCHERS

Question: How many units have actually been funded under the Experimental Housing Allowance Program? Over what length of time?

Answer: Twelve Annual Contributions Contracts were authorized for over 17,000 units for the Experimental Housing Allowance Program over a 2-10 year period. During that time, as a result of turnover, more than 30,000 households received housing assistance.

Question: What was the per unit subsidy under the Experimental Housing Allowance Program?

Answer: The per unit monthly subsidy (in 1974 dollars) was $96.00. The allowance payment was $75.00 and the administrative cost was $21.00.

Question: In what areas was this program conducted?

Answer: The experiment was composed of three separate experiments. The experiments, location and number of years are as follows:

1. The Demand Experiment - 3 years

   - Allegheny County, Pa.
   - Maricopa County, Ariz.

2. The Supply Experiment - 5 years (plus an additional 5 year commitment of allowance payment)

   - Green Bay, Wi.
   - South Bend, In.

3. Administrative Agency Experiment - 2 years

   - Bismarck, N.D.
   - Durham, N.C.
   - Jacksonville, Fl.
   - San Bernardino, Ca.
   - Salem, Or.
   - Peoria, Ill.
   - Springfield, Ma.
   - Tulsa, Ok.

Senator Huddleston—Continued

Question: How many vouchers do you expect to actually get into eligible party hands in FY 84?

Answer: The Budget assumes that no vouchers will be occupied in FY 1984. In FY 1985, an estimated 12,000 of the 15,000 Vouchers reserved in FY 1984 will be under payment.

Question: What are the actual mechanics of converting a relinquished Section 8 existing certificate into a voucher?

Answer: As originally proposed, HUD had intended to begin converting certificates to vouchers during FY 1985 by requiring PHAs to issue vouchers as families leave the Section 8 Existing program through normal turnover. The transition to vouchers during FY 1985 was intended to occur only upon tenant turnover and subsidy funds in the current Section 8 Existing ACC would be used to assist new families under the voucher program. We have been advised that additional appropriation language may be required to enable HUD to offer vouchers for this purpose--and this proposal is on hold pending a resolution of the legal issue.

Question: Are we in effect just directing that 160,000 families--or some portion thereof--move?

Answer: The Department is not directing that 160,000 families move. The 160,000 replacement vouchers will assist new families only. The Section 8 Existing program has traditionally noticed a turnover (or relinquishment) of certificate at almost a 20% annual rate. The availability of vouchers will therefore replace the relinquished Section 8 Existing Certificate in order to maintain a subsidized housing level.

RENTAL HOUSING DEVELOPMENT GRANT ELIGIBILITY

Question: HUD was supposed to release a list of eligible cities by January 29, why was this deadline not met?

Answer: HUD attempted to explore all possible options to develop an eligibility system which best measured a "severe shortage of decent rental housing opportunities." This process itself was highly time-consuming and staff intensive. In addition, HUD faced severe limitations on the availability of Census data. Because of Bureau of Census workload (particularly Revenue Sharing), we were not able to obtain special Census computer data runs within that time frame. We found it necessary to hand code for the computer much of the data from printed Census sources. This hand coding and computer tape development took many weeks of staff effort.

Originally the HUD list contained 41 large cities (over 50,000 in population) and 576 total places counting medium-size cities, small cities, townships, and Puerto Rican municipalities. The Congressional Budget Office list now contains 133 large cities and 1,818 places. Some places included on the original HUD list do not appear on the CBO list. The difference in the number and identity of the cities eligible occur because the CBO list sets a substantially lower threshold for eligibility and because the new list uses somewhat different factors to measure the need.

The most important point to be made is that the list, no matter how long or short, simply identifies a city that has an opportunity to submit applications. This is not an entitlement program and no city is guaranteed funding by virtue of appearing on the eligibility list. In addition, cities not on the eligibility list can still successfully apply for, and receive funding for, projects that demonstrate a special housing need or are pursuant to a neighborhood preservation goal. The change in the list is not a departure from the established HUD position that few cities are experiencing a severe shortage of rental housing units; instead, it represents a compromise.

Question: I understand that four different sets of criteria which would, of course, have resulted in four different lists, were considered. Is that correct?

Answer: HUD staff prepared and analyzed more than twenty different sets or combinations of criteria during the development of the eligibility system. All were considered at one time or another in the review and decision-making process.

Both HUD and CBO used the same statutory factors to determine eligibility. The statute contained five suggested eligibility factors: extent of poverty; the extent of occupancy of physically inadequate housing by lower-income families; extent of housing overcrowding experienced by lower-income families; level and duration of rental housing vacancies; and, the extent of the lag between estimated need for and the production of rental housing. The statute allowed HUD to add eligibility factors of its own, but the Department did not choose to do so. Neither HUD nor CBO could find an appropriate surrogate for the fifth statutory factor; thus, both systems used the first four statutory factors.

Question: Please provide each of the four criteria considered and a list of communities which would have been eligible under each.

The HUD system identified measures from the 1980 Census for the four factors. HUD then evaluated the scores for each of the nation's large cities to determine a median for the four factors. Cities that scored below the median received no score for that factor. Cities scoring above the median in any factor could receive from 1 to 4 points based on the the need demonstrated. A city could score up to 16 points with this system. The minimum score for eligibility was 9.

HUD used four basic measures for the 1980 Census to assign points:

1. For extent of poverty, HUD measured both the presence and the growth of poverty in a community. The presence of poverty was measured by the percentage of a locality's families that were in poverty as of the 1980 Census. The growth of poverty was shown by the increase in the number of poverty persons between the 1970 Census and the 1980 Census. Poverty growth was considered because it is unlikely that the private sector would build new housing units for a growing population of poor people.

2. For extent of occupancy of physically inadequate housing by lower income families, HUD used 1980 Census data on the

percent of rental units in pre-1940 structures occupied by poverty households. This measure combines characteristics that must occur together to identify inadequate housing: rental units, age of housing stock, and poverty households.

3. Level and duration of vacancies is available from the 1980 Census in a straightforward manner. HUD split the two elements. Up to two points were assigned for communities that had very low vacancy rates. Up to two points were assigned for vacancies under two months in duration.

4. A measure of rental overcrowding is available in the 1980 Census. That was used to measure lower-income overcrowding.

The CBO system made changes in the HUD methodology; some were subtle, but one was significant. CBO used the same four statutory criteria and also assigned each a value of four points. The significant change was the lowering of the threshold from 9 to 6 points. That, and that alone, results in the dramatic increase in the number of eligible cities. Attached is a copy of the eligibility list according to the CBO criteria.

Question: Why did you choose the one you did?

Answer: The eligibility option chosen by HUD was considered to contain measures that (1) were closest to the factors spelled out in the statute, and (2) best reflected a "severe shortage of decent rental housing opportunities for families and individuals without reasonable and affordable housing alternatives in the private market." The statutory language and factors direct the grants to areas that not only have relatively poor quality rental housing and low-income tenants, but which also have tight market conditions that new construction and substantial rehabilitation may be able to alleviate.

Question: Doesn't the set of criteria skew the program toward the South and the West?

Answer: The percentage of each region's total of places over 2,500 population that were eligible on the original HUD list was as follows: Northeast--10.8 percent of total Northeast places; North Central-- 2.7 percent of total North Central places; South-- 13.6 percent of total Southern places; and West--9.5 percent of total Western places. In addition, these figures do not include the 99 towns and townships in the Northeast and North Central regions that also are eligible. Thus, there is not a great deal of difference between the percent eligible in the Northeast, South, and West regions. The statutory factors of low vacancy rates and high overcrowding tend to prevail in the West, the Southwestern sub-region of the South, and in some places in the Northeast particularly those in New Jersey. The proxy for inadequate housing--rental units in pre-1940 structures and occupied by poverty households--tends to favor the Northeast and, to some extent, helps the North Central places (but not enough to overcome the other less favorable regional factors).

The changes in the factors introduced by CBO caused a regional shift in the eligibility list. The changes are:

1. The CBO eliminated the growth of poverty component in the extent of poverty factor and went with a straight measure of poverty families. This resulted in a shift away from the growth areas of the Southwest and West to the high poverty (but no growth) areas of the North Central and Northeast states.

2. CBO used the HUD measure of physically inadequate housing.

3. CBO used an intermediate step to change the scoring on vacancies. CBO combined the two scores that HUD had used as two separate two-point categories. In combining the two elements of level and duration, CBO set a higher threshold for scoring points in the vacancy category. The practical result is that a city scoring 3 points under the HUD system would probably score 2 points for vacancy under CBO. A city scoring 2 points or less under the HUD system would likely score 0 under the CBO system. This change makes it more difficult to score vacancy points. In general, this favors the East over the tight rental markets of the West.

4. The CBO used the same measure of overcrowding as HUD, but made it more difficult to score points under that factor. With the HUD system, a community could score points if it was in the top 50 percentile in overcrowding. Under the CBO method, a city had to be in the top 25 percentile to score points. Cities with the most severe overcrowding would score 4 under both HUD and CBO systems. However, it a city scored 3 points on the HUD system, they would score 2 points on CBO; and, scores of 2 or 1 from HUD resulted in scores of 0 from CBO. This lowered scores in the Southwest, the West, and in New Jersey.

Question: How do you explain the exclusion of cities such as Boston, Birmingham, Louisville, and Pittsburgh but the inclusion of cities such as New York, New Orleans, and Chicago?

Answer: A draft list did exclude cities such as Boston, Birmingham, Louisville, and Pittsburgh generally because they lost points on the statutory factors of vacancies and overcrowding. In some cases, because of loss of persons in poverty between 1970 and 1980, they also lost on the poverty growth component of the poverty measure. Cities included on the draft list, such as New York, New Orleans, and Chicago generally had high overcrowding, a high percentage of families in poverty and an increase in poverty persons between 1970 and 1980, and, in some cases, low vacancy rates.

However, these cities have been included on subsequent lists, such as the CBO list alluded to earlier.

Question: How many states have no qualifying areas?

Answer: The following six States have no qualifying areas on the new (CBO) list: Hawaii, Montana, Nebraska, North Dakota, Oregon, and Wyoming. The original HUD list also excluded areas in Oregon.

Question: Doesn't the State of Virginia present something of an anomaly?

Answer: On the original HUD list, some cities in the State of Virginia tended to score low on a combination of factors, often having both high vacancy rates and loss of persons in poverty between 1970 and 1980. There are now twelve cities in Virginia on the new list.

ALABAMA

Abbeville
Aliceville
Andalusia
Anniston
Atmore
Auburn
Bay Minette
Bessemer
Birmingham
Brent
Bridgeport
Brighton
Brundidge
Centreville
Childersburg
Citronelle
Clanton
Columbiana
Cordova
Dadeville
Daleville
Daphne
Demopolis
Eufaula
Evergreen
Fairfield
Gadsden
Graysville
Greensboro
Greenville
Hartford
Headland
Hokes Bluff
Lafayette
Linden
Lipscomb
Livingston
Luverne
Marion
Monroeville
Montgomery
Opelika
Phenix City
Piedmont
Pleasant Grove
Prichard
Red Bay
Roanoke
Roosevelt City
Russellville
Selma
Sheffield
Stevenson
Sumiton
Sylacauga
Talladgeg
Thomasville
Troy
Tuskegee
Union Springs
Wetumpka
York

ALASKA

Bethel

ARIZONA

Avondale
Bisbee
Buckeye
Casa Grande
Chandler
Chino Valley
Coolidge
Douglas
Edgar
El Mirage
Eloy
Florence
Guadalupe
Holbrook
Miami
Nogales
Parker
Somerton
South Tucson
St. Johns
Superior
Surprise
Thatcher
Tolleson
Winslow

ARKANSAS

Augusta
Blytheville
Booneville
Brinkley
Camden
Carlisle
Clarksville
Corning
Dewitt
Demott
Dumas
Earle
El Dorado
England
Eudora
Forrest City
Hamburg
Helena
Hot Springs
Hoxie
Lake Village
Magnolia
Malvern
Manila
Marianna
Marked Tree
McGehee
Mena
Monticello
Newport
Osceola
Paragould
Pine Bluff
Prescott
Stamps
Waldron
Walnut Ridge
Warren
West Helena
West Memphis
Wynne

CALIFORNIA

Arcata
Artesia
Arvin
Avenal
Azusa
Baldwin Park
Banning
Barstow
Bell

Senator Huddleston—Continued

Bell Gardens
Berkeley
Blythe
Brawley
Brentwood
Calexico
Cloverdale
Coachella
Colton
Commerce
Compton
Corcoran
Cotati
Cudahy
Daly
Delano
Dinuba
Dos Palos
Duarte
El Centro
El Monte
Exeter
Farmersville
Fillmore
Firebaugh
Fresno County
Galt
Garden Grove
Gardena
Gilroy
Gonzales
Greenfield
Gridley
Guadalupe
Hawaiian Gardens
Hollister
Hughson
Huntington Park
Huron
Imperial Beach
Indio
Ingleswood
King City
La Puente
Lake Elsinore
Lawndale
Lindsay
Live Oak
Livingston
Los Angeles
Los Banos
Lynwood
Madera
Marina
Maywood
McFarland
Mendota
Merced
Montebello
National City
Newark
Newman
Norwalk
Oakland
Orange Cove
Oroville
Oxnard
Paramount
Parlier
Pasadena
Patterson
Perris
Pittsburg
Placentia
Pomona
Porterville
Redwood City
Reedley
Richmond
Riverbank
Rosemead
Ross
Salinas
San Bernadino
San Fernando
San Francisco
San Gabriel
San Jacinto
San Jose
San Pablo
Sanger
Santa Ana
Santa Cruz
Santa Fe Springs
Sana Paula
Seaside
Selma
Soledad
South El Monte
South Gate
Stockton
Tulare
Union City
Wasco
Winters
Woodlake

COLORADO

Alamosa
Delta
Fort Lupton
La Junta
Lamar
Las Animas
Monte Vista
Rocky Ford
Trinidad
Walsenburg

CONNECTICUT

Bridgeport
Danielson
Hartford
Jewett City
New Haven
New London
Norwich
Stafford Springs

DELAWARE

Laurel
Milford
New Castle
Smyrna
Wilmington

DISTRICT

Washington

FLORIDA

Alachua
Apalachicola
Apopka
Arcadia
Avon Park
Bartow
Belle Glade
Blountstown
Bonifay
Brooksville
Chipley
Clewiston
Cocoa
Dade County
De Funiak Spring
De Land
Florida City
Fort Meade
Fort Pierce
Graceville
Green Cove Spring
Haines City

Senator Huddleston—Continued

Havana
Hialeah
Homestead
Key West
Lake City
Live Oak
Mac Clenny
Madison
Marianna
Miami
Miami Beach
Monticello
Mount Dora
Mulberry
Ocala
Opalocka
Pahokee
Palatka
Palmetto
Pensacola
Perry
Plant City
Quincy
Riviera Beach
Sanford
South Bay
South Miami
Springfield
St. Augustine
Starke
Sweetwater
Tampa
West Miami
West Palm Beach
Wildwood
Winter Garden

GEORGIA

Adel
Albany
Alma
Americus
Ashburn
Athens
Atlanta
Augusta
Bainbridge
Barnesville
Baxley
Blackshear
Blakely
Brunswick
Cairo
Camilla
Canton
Cedarton
Claxton
Cochran
Cordele
Covington
Cuthbert
Dawson
Donalsonville
Douglas
Dublin
East Dublin
Eastman
Eatonton
Elberton
Fitzgerald
Forsyth
Fort Valley
Glennville
Gordon
Greensboro
Griffin
Hartwell
Hawkinsville
Hazlehurst
Hogansville
Homerville
Jackson
Jesup
La Grange
Lakeland
Lithonia
Louisville
Lyons
Macon
Madison
McDonough
McRae
Metter
Milledgeville
Millen
Monroe
Montezuma
Moultrie
Newman
Ocilla
Pelham
Perry
Quitman
Rockmart
Rome
Sandersville
Savannah
Social Circle
Soperton
Statesboro
Summerville
Swainsboro
Sylvania
Sylvester
Thomaston
Thomasville
Thomson
Tifton
Valdosta
Vidalia
Vienna
Villa Rica
Washington
Waycross
Waynesboro
West Point
Winder
Wrightsville

IDAHO

Blackfoot
Emmett
Fruitland
Heyburn
Montpelier
Payette
Sandpoint
St. Anthony
Weiser

ILLINOIS

Aledo
Benton
Cairo
Carrollton
Centreville
Chicago
Chicago Heights
Columbia
Danville
East Chicago Heights
East St. Louis
Eldorado
Fairfield
Green Rock
Harvey
Havana
Johnston City
Madison
Markham
Maywood
McLeansboro
Metropolis
Naperville
Phoenix
Robbins
Round Lake Beach
Sandwich
South Holland
Stone Park
Summit

Senator Huddleston—Continued

Venice
Washington Park
Waterloo
White Hall

INDIANA

Austin
Bicknell
Bloomington
East Chicago
Edinburg
Gary
Hanover
Knox
Lawrenceburg
Linton
Mount Vernon
Munice
New Castle
North Vernon
Richmond
St. John
Vincennes
West Lafayette
West Terre Haute

IOWA

Centerville
Manchester
Sioux Center

KANSAS

Abilene
Baxter Springs
Coffeyville
Columbus
Marysville
Neodesha
Pittsburg

KENTUCKY

Bardstown
Bowling Green
Catlettsburg
Central
Columbia
Covington
Cumberland
Cynthiana
Dawson Springs
Dayton
Flemingsburg
Franklin
Fulton
Georgetown
Grayson
Harlan
Harrodsburg
Hartford
Hickman
Hodgenville
Irvine
Jackson
Lancaster
Lebanon
Louisville
Ludlow
Mayfield
Maysville
Middlesborough
Monticello
Mount Sterling
Newport
Olive HIll
Paduacah
Paris
Pikeville
Pineville
Providence
Richmond
Scottsville
Shelbyville
Somerset
Springfield
Stanford
Tompkinsville
Vine Grove
Williamsburg
Winchester

LOUISIANA

Abbeville
Alexandria
Amite City
Arcadia
Baldwin
Basile
Bastrop
Bogalusa
Breaux Bridge
Broussard
Bunkie
Carencro
Church Point
Covington
Crowley
Delhi
Donaldsonville
Eunice
Farmerville
Ferriday
Franklin
Franklinton
Gramercy
Gretna
Hammond
Haynesville
Homer
Houma
Jeanerette
Jennings
Jonesville
Kaplan
Kentwood
Kinder
Lake Arthur
Lake Providence
Leesville
Lutcher
Mamou
Mansfield
Many
Marksville
Minden
Monroe
Morgan City
Natchitoches
New Iberia
New Orleans
New Roads
Oakdale
Opelousas
Plaquemine
Ponchatoula
Port Allen
Port Barre
Rayne
Rayville
Shreveport
St. Martinville
Tallulah
Thibodaux
Ville Platte
Welsh
Westwego
Winnfield
Winnsboro
Zwolle

MAINE

Bath
Belfast
Calais
Caribou
Portland

Senator Huddleston—Continued

Rockland
Waterville

MARYLAND

Baltimore
Cambridge
Capitol Heights
Chestertwon
Crisfield
Cumberland
Fruitland
Pocomoke City
Seat Pleasant

MASSACHUSETTS

Boston
Brockton
Cambridge
Chelsea
Fall River
Holyoke
Lawrence
Lynn
New Bedford
North Adams
Northampton
Springfield

MICHIGAN

Alma
Battle Creek
Bay City
Benton Harbor
Big Rapids
Boyne City
Caro
Chedar Springs
Cheboygan
Detroit
Dundee
East Grand Rapid
Ecorse
Essexville
Flint
Franklin
Grand Rapids
Grosse Pointe FA
Hamtramck
Highland Park
Houghton
Ironwood
Jackson
Kalamazoo
Laurium
Monroe
Mount Morris
Muskegon
Muskegon Heights
Nile
Pontiac
Port Huron
River Rouge
Saginaw
Sault Sainte Mar
Sparta
St Johns
St Louis
Ypsilanti
Zeeland

MINNESOTA

Bemidji
Brainerd
Dayton
Deephaven
Fairmont
Minnetrista
Park Rapids
Sauk Centre
Staples

MISSISSIPPI

Aberdeen
Amory
Batesville
Belzoni
Brookhaven
Canton
Carthage
Charleston
Clarksdale
Cleveland
Columbia
Columbus
Crystal Springs
Drew
Durant
Forest
Greenville
Greenwood
Grenada
Hattiesburg
Hazlehurst
Hernando
Hollandale
Holly Springs
Horn Lake
Houston
Indianola
Itta Bena
Jackson
Kosciusko
Laurel
Leland
Lexington
Louisville
Magee
McComb
Mendenhall
Meridian
Morton
Moss Point
Mound Bayou
Natchez
Newton
Okolona
Pass Christian
Poplarville
Quitman
Rolling Fork
Rosedale
Ruleville
Senatobia
Shelby
Vicksburg
Water Valley
Waynesboro
West Point
Wiggins
Winona
Yazoo City

MISSOURI

Aurora
Ava
Bethany
Butler
Caruthersville
Charleston
Desloge
East Prairie
Flat River
Fredericktwon
Hayti
Kennett
Kinloch
Lexington
Malden
Mountain Grove
New Madrid
Pagedale
Pine Lawn
Poplar Bluff
Portageville
Potosi

Senator Huddleston—Continued

Sedalia
St. Clair
St. Louis
Valley Park
Wellston

NEVADA

North Las Vegas

NEW HAMPSHIRE

Keene

NEW JERSEY

Asbury Park
Atlantic City
Beachwood
Beverly
Bradley Beach
Bridgeton
Buena
Camden
Closter
Dover
East Orange
Elizabeth
Gloucester City
Haledon
Harrington Park
Harrison
Hoboken
Hudson County
Irvington
Jersey City
Keyport
Kinnelon
Lakehurst
Moonachie
New Brunswick
Newark
Northfield
Passaic
Paterson
Paulsboro
Pennis Grove
Perth Amboy
Pitman
Plainfield
Prospect Park
Rockaway
Salem
South Amboy
South Toms River
Trenton
Union Beach
Union City
Washington
West New York
Wildwood
Woodbine
Woodstown

NEW MEXICO

Bayard
Bernalillo
Bloomfield
Clayton
Deming
Espanola
Gallup
Jal
Las Vegas
Lordsburg
Los Lunas
Lovington
Portales
Raton
Silver City
Socorro
Taos
Truth or Consequences
Tucumcari
Tularosa

NEW YORK

Albany
Alfred
Babylon
Bath
Binghamton
Brockport
Buffalo
Canastota
Canton
Carthage
Chittenango
Cornwall on Hudson
Cortland
Croton-on-Hudson
Dansville
Dunkirk
East Aurora
Ellenville
Elmira
Elmsford
Fort Edward
Fredonia
Freeport
Fulton
Geneseo
Gloversville
Gouverneur
Granville
Hamburg
Hamilton
Haversrtraw
Hempstead
Herkimer
Hilton
Homer
Hornell
Hudson
Ilion
Ithaca
Kings Point
Kingston
Larchmont
Liberty
Malone
Malverne
Massena
Middletown
Mohawk
Mount Vernon
New Rochelle
New York
Newburgh
Niagara Falls
North Tarrytown
Nyack
Ogdensburg
Oneonta
Pelham
Penn Yan
Plattsburgh
Port Chester
Port Jervis
Potsdam
Poughkeepsie
Rensselaer
Rochester
Schenectady
Silver Creek
Skaneateles
Sloatsburg
Springville
Syracuse
Ticonderoga
Troy
Utica
Walden
Watertown
Whitesboro

NORTH CAROLINA

Ahoskie
Belmont

Senator Huddleston—Continued

Benson
Bessemer City
Canton
Clayton
Clinton
Dallas
Dunn
Edenton
Elizabeth City
Elizabethtown
Enfield
Fairmont
Farmville
Granite Falls
Havelock
Henderson
Hendersonville
Hillsborough
Kinston
Louisburg
Lowell
Madison
Maxton
Monroe
Mount Airy
Mount Olive
Murfreesboro
Nashville
New Bern
Oxford
Pembroke
Plymouth
Red Springs
Reidsville
Rocky Mount
Roxboro
Rutherfordton
Scotland Neck
Selma
Shelby
Smithfield
Spindale
Spring Lake
Tabor City
Troy
Wadesboro
Wake Forest
Warsaw
Washington
Waynesville
Williamston
Wilmington
Wilson

OHIO

Athens
Barnesville
Bellaire
Bridgeport
Cedarville
Cincinnati
Cleveland
Cleveland Height
Coal Grove
Crooksville
Dayton
Dennison
East Cleveland
East Liverpool
East Palestine
Elmwood Place
Fremont
Gallipolis
Georgetown
Girard
Greenfield
Hamilton City
Highland Heights
Itonton
Jackson
Jefferson
Lima
Lincoln Heights
Logan
Millersburg
Nelsonville
New Boston
New Lexington
New Miami
New Richmond
Pomeroy
Portsmoutn
Sabina
Shadyside
South Lebanon
Springfield
St. Clarisville
Steubenville
Toledo
Uhrichsville
Washington
Wellston
Wellsville
West Union
Windham
Woodlawn
Yellow Springs
Youngstown
Zanesville

OKLAHOMA

Ada
Anadarko
Antlers
Ardmore
Atoka
Bristow
Broken Bow
Chandler
Checotah
Chickasha
Clinton
Commerce
Coweta
Drumright
Durant
Eufaula
Glenpool
Guthrie
Heavener
Henryetta
Hobart
Holdenville
Hollis
Idabel
Madill
Mangum
Marlow
Muskogee
Okemah
Okmulgee
Pauls Valley
Pawhuska
Poteau
Purcell
Sayre
Seminole
Shawnee
Stigler
Sulphur
Tahlequah
Tishomingo
Vinita
Wagoner
Walters
Wewoka

OREGON

Molalla
Nyssa

PENNSYLVANIA

Akron
Ashland
Avoca
Beaver Falls
Bentleyville
Boyertown
Braddock

Senator Huddleston—Continued

Bradford
Bristol
Brownsville
Centreville
Chester
Clairton
Coatesville
Colwyn
Connellsville
Darby
Donora
Duquesne
Easton
Eddystone
Erie
Farrell
Fountain Hill
Gettysburg
Greencastle
Harrisburg
Homestead
Indiana
Johnstown
Lancaster
Lehighton
Lewistown
Lititz
Lock Haven
Mansfield
Marcus Hook
Masontown
Mckees Rocks
McKeesport
Mercer
Meyersdale
Midland
Mount Penn
New Castle
New Kensington
Oakmont
Parkesburg
Philadelphia
Philipsburg
Pittsburgh
Pittston
Plymouuth
Port Allegany
Portage
Pottsville
Rankin
Reading
Sayre
Shamokin
Shenandoah
Shillington
State College
Summit Hill
Sunbury
Tarentum
Throop
Titusville
Towanda
Union City
Uniontown
Upland
Washington
Williamsport
York

RHODE ISLAND

Central Falls
Newport
Providence
Woonsocket

SOUTH CAROLINA

Abbeville
Allendale
Anderson
Andrews
Bamberg
Barnwell
Batesburg
Bennettsville
Bishopville
Blackville
Charleston
Cheraw
Chester
Clover
Darlington
Denmark
Dillon
Edgefield
Florence
Fort Mill
Gaffney
Georgetown
Great Falls
Greenwood
Greer
Hartsville
Johnston
Kingstree
Lake City
Lancaster
Laurens
Liberty
Manning
Marion
McColl
Mullins
Orangeburg
Pageland
Saluda
Spartanburg
Sumter
Walterboro
Williamston
Winnsboro
Woodruff
York

SOUTH DAKOTA

Mobridge
Sisseton
Spearfish
Vermillion
Winner

TENNESSEE

Alamo
Bolivar
Brownsville
Collierville
Columbia
Covington
Elizabethton
Etowah
Fayetteville
Henderson
Humboldt
Jellico
Lawrenceburg
Lexington
Loudon
McKenzie
Memphis
Milan
Monterey
Mount Pleasant
Oliver Springs
Oneida
Pulaski
Ripley
Savannah
Sevierville
Smithville
South Fulton
Sparta
Springfield
Trenton
Winchester

TEXAS

Alamo

Senator Huddleston—Continued

Alice
Alpine
Alton
Alvarado
Andrews
Anthony
Arkansas Pass
Athens
Ballinger
Bastrop
Bay City
Beeville
Belton
Big Lake
Big Spring
Bishop
Brady
Brazoria
Brownfield
Brownsville
Cameron
Carrizo Springs
Center
Childress
Clarksville
Cleveland
Clute City
Cockrell Hill
Coleman
Colorado City
Comanche
Corpus Christi
Corsicana
Cotulla
Crockett
Crystal City
Cuero
Del Rio
Devine
Diboll
Dilley
Dimmitt
Donna
Eagle Lake
Eagle Pass
Edcouch
Edinburg
El Campo
El Paso
Elgin
Elsa
Ennis
Falfurrias
Floresville
Floydada
Fort Stockton
Fredericksburg
Freer
Friona
Gatesville
George West
Giddings
Gonzales
Gregory
Groesbeck
Hamlin
Harlingen
Haskell
Hearne
Hempstead
Hereford
Hondo
Hutchins
Jacksonville
Jasper
Jefferson
Jourdanton
Junction
Karnes City
Kaufman
Kenedy
Killeen
Kingsville
Kountze
La Freria
La Grange
Lamesa
Lampasas
Laredo
Levelland
Littlefield
Llano
Lockhart
Lufkin
Luling
Madisonville
Marble Falls
Marlin
Marshall
Mathis
Mc Allen
McGregor
McKinney
Memphis
Mercedes
Mexia
Mission
Monahans
Morton
Muleshoe
Navasota
Palestine
Paris
Pearsail
Pecos
Pharr
Plainview
Pleasanton
Port Arthur
Port Isabel
Port Lavaca
Post
Poteet
Premont
Raymondville
Refugio
Richmond
Robstown
Rockport
Roma
San Antonio
San Augustine
San Benito
San Diego
San Juan
San Marcos
San Saba
Seagraves
Sealy
Seguin
Seminole
Sinton
Slaton
Smithville
Sonora
South Houston
Stamford
Sweetwater
Taft
Tahoka
Taylor
Teague
Terrell
Trinity
Tulia
Uvalde
Van Horn
Vernon
Victoria
Waxahachie
Wellington
Weslaco
Wharton
Winnesboro
Winters
Yoakum

UTAH

Clinton
Ephraim

Payson
Provo
South Jordan
Washington

VERMONT

Barre
Bellows Falls
Newport
St. Albans
Swanton
Winooski

VIRGINIA

Blackstone
Chase City
Coeburn
Culpepper
Orange
Petersburg
Portsmouth
Richmond
Roanoke
South Hill
Warrenton
Wytheville

WASHINGTON

Clarkston
Grandview
Othello
Pasco
Pullman
Sunnyside
Toppenish
Wapato

WEST VIRGINIA

Buckhannon
Charles Town
Fairmont
Grafton
Hinton
Keyser
Lewisburg
Martinsburg
Mullens
Philippi
Ripley
Salem
Weston
Williamson

WISCONSIN

Antigo
Beaver Dam
Berlin
Bloomer
Combined Locks
Jefferson
Kiel
Ladysmith
Medford
Menomonie
Neillsville
Platteville
River Falls
Waupun
Whitewater

PUERTO RICO

Arecibo
Bayamaon Municipio
Caguas Municipio
Carolina Municipio
Guaynabo Municipio
Mayaguez Municipio
Ponce Municipio
San Juan Municipio
Toa Baja Municipio
Trujillo Alto Municipio

PUERTO RICO UNDER 50,000 POPULATION

Adjuntas
Aguada
Aguas Buenas
Aibonito
Anasco
Arroyo
Barceloneta
Barranquitas
Cabolrrojo
Camuy
Canovanas
Catano
Cayey
Ceiba
Ciales
Cidra
Coamo
Comerio
Corozal
Culebra
Dorado
Fajardo
Florida
Guanica
Guayama
Guayanilla
Gurabo
Hatillo
Hormiqueros
Humacao
Isabela
Jayuya
Juanalodiaz
Juncos
Lajas
Lares
Las Marias
Las Piedras
Loiza
Luquillo
Manati
Maricao
Munabo
Moca
Morovis
Naguabo
Naranjito
Orocovis
Patillas
Penuelas
Querbradillas
Rincon
Rio Grande
Sabana Grande
Salinas
San German
San Lorenzo
San Sebastian
Santa Isabel
Tao Alta
Utaudo
Vega Alta
Vega Baja
Vieques
Vilalba
Yabucoa
Yauco

Senator Huddleston—Continued

TOWNS AND TOWNSHIPS

CONNECTICUT

Brooklyn Town - Windham County
Durham Town - Middlesex County
Granby Town - Hartford County
Kent Town - Litchfield County
New Fairfield - Fairfield County
North Stonington Town - New London County
North Canaan Town - Litchfield County
Portland Town - Middlesex County
Salisbury Town - Litchfield County
Woodstock Town - Windham County

MAINE

Brunswick Town - Cumberland County
Falmouth Town - Cumberland County
Fort Fairfield Town - Aroostook County
Fort Kent Town - Aroostook County
Houlton Town - Aroostook County
Livermore Town - Androscoggin
New Glouchester Town - Cumberland County
Poland Town - Androscoggin County
Sabattos Town - Androscoggin County
VanBuren Town - Aroostock County

MASSACHUSETTS

Amherst Town - Hampshire County
Avon Town - Norfold County
Burlington Town - Middlesex County
Dedham Town - Norfold County
Dighton Town - Bristol County
East Bridgewater Town - Plymouth County
Essex Town - Essex County
Greenfield Town - Franklin County
Hadley Town - Hampshire County
Hanover Town - Plymouth County
Kington Town - Plymouth County
Lenox Town - Berkshire County
Marion Town - Plymouth County
Mattaroisett Town - Plymouth County
Millbury Town - Worcester County
Paxton Town - Worcester County
Province Town - Barnstable County
Salisbury Town - Essex County
South Hadley - Hampshire County
Sunderland - Franklin County
Swansea Town - Bristol County
West Newbury Town - Essex County
Westminster Town - Worcester County
Whitman Town - Plymouth County
Wrentham Town - Norfolk County

Senator Huddleston—Continued

TOWNS AND TOWNSHIPS (continued)

Michigan

Albee Township - Saginaw County
Arbela township - Tuscola County
Atlas Township - Genesee County
Attica Township - Lapeer County
Aurelius Township - Ingham County
Bainbridge Township - Berrien County
Bennington Township - Shiawassee County
Benton Township - Berrien County
Buchanan Township - Berrien County
Burns Township - Shiawassee County
Chesaning Township - Saginaw County
Cooper Township - Kalamazoo County
Courtland Township - Kent County
Covert Township - Van Buren County
Deerfield Township - Livingston County
Geneva Township - Van Buren County
Green Lake Township - Grand Traverse County
Hagar Township - Berrien County
Hartford Township - Van Buren County
Hayes Township - Clare County
Henrietta Township - Jackson County
Howard Township - Cass County
Ida Township - Monroe County
Jefferson Township - Hillsdale County
Keeler Township - Van Buren County
La Salle Township - Monroe County
Manistee Township - Manistee County
Maplegrove Township - Saginaw County
Marathon Township - Lapeer County
Millington Township - Tuscola County
Mills Township - Ogeman County
Oronoko Township - Berrien County
Otsego Township - Allegan County
Peninsula Township - Grand Traverse County
Plainfield Township Iosco County
Portage Township - Houghton County
Praireville Township - Barry County
Raisin Township- Lenawee County
Ray Township - Macomb County
Richland Township - Saginaw County
Robinson Township - Ottawa County
Roscommon Township - Roscommon County
Rose Township - Oakland County
Royal Oak Township - Oakland County
Unadilla Township - Livingston County
Vassar Township - Tuscola county
Venice Township - Shiawassee County
Vernon Township - Isabella County
Watertown Township - Clinton County
Zeeland Township - Ottawa County

TOWNS AND TOWNSHIPS (continued)

New Hampshire

Allentown Town - Grafton County
Candia Town - Rockingham County
Durham Town - Strafford County
Gorham Town - Coos County
Hanover Town - Grafton County
Lancaster Town - Coos County
North Hampton Town - Rockingham County
Northfield Town - Merrimack County
Winchester Town - Cheshire County

New Jersey

Bedminster Township - Somerset County
Buena Vista Township - Atlantic County
Commercial Township - Cumberland County
Delanco Township - Burlington County
East Greenwich Township - Gloucester County
Fairfield Township - Cumberland County
Greenwich Township - Cumberland County
Harding Township - Morris County
Hardyston Township - Susses County
Holland Township - Hunterdon County
Hopewell Township - Cumberland County
Logan Township - Gloucester County
Mendham Township - Morris County
Millstone Township - Monmouth County
Mount Holly Township - Burlington County
Mullica Township - Atlantic County
New Hanover Township - Burlington County
North Bergen Township - Hudson County
Pilesgrove Township - Salem County
Pittsgrove Township - Salem County
Quinton Township - Salem County
Shamong Township - Burlington County
Southampton Township - Burlington County
Springfield Township - Burlington County
Tabernacle Township - Burlington County
Weehaken Township - Hudson County
Wyckoff Township - Bergen County

TOWNS AND TOWNSHIPS (continued)

New York

Argyle Town - Washington County
Aurora Town - Eric County
Beekman Town - Dutchess County
Cairo Town - Greene County
Cambria Town - Niagara County
Canton Town - St. Lawrence County
Caroline Town - Tompkins County
Carroll Town - Chautauqua County
Catlin Town - Chemung County
Charlton Town - Saratoga County
Chester Town - Warren County
Clarence Town - Erie County
Colden Town - Eire County
Copake Town - Columbia County
Cornwall Town - Orange County
Deerfield Town - Oneida county
Deerpark Town - Orange County
Delaware Town - Sullivan County
Ellisburg Town - Jefferson County
Fallsburg Town - Sulllivan County
Fort Ann Town - Washington County
Goshen Town - Orange County
Granville Town - Washington County
Greenville Town - Greene County
Hanover Town - Chantauqua
Hopewell Town - Ontario County
Jerusalem Town - Yates County
Lake Luzerne - Warren County
Lansing Town - Tompkins County
Lewisboro Town - Westchester County
Lewiston Town - Niagara County
Lisbon Town - St. Lawrence County
Malone Town - Franklin County
Mamakating Town - Sullivan County
Mamaroneck Town - Westchester County
Marilla Town - Erie County
Moriah Town - Essex County
Norfolk Town - St. Lawrence County
Oneonta Town - Otsego County
Oswegatichie Town - St. Lawrence County
Palermo Town - Oswego County
Parma Town - Monroe County
Richland Town - Oswego County
Riga Town - Monroe County
Rochester Town - Ulster County
Rockland Town - Wullivan County
Rose Town - Wayne County

TOWNS AND TOWNSHIPS (continued)

New York (continued)

Shandaken Town - Ulster County
Sullivan Town - Madison County
Trenton Town - Oneida County
Verona Town - Oneida County
Vienna Town - Oneida County
Waterloo Town - Seneca County
Wheatfield Town - Niagara County

Pennsylvania

Alsace Township - Berks County
Amwell Township - Washington County
Armagh Township - Miffin County
Barrett Township - Monroe County
Bradford Township - Clearfield County
Brecknock Township - Lancaster County
Bushkill Township - Northhampton County
Butler Township - Schuylkill County
Carroll Township - Washington County
Chanceford Township - York County
Coal Township - Northumberland County
Conemaugh Township - Cambrin County
Cowanshannock Township - Armstrong County
Croyle Township - Cambrin County
Damacus Township - Wayne County
Derry Township - Mifflin County
Dunbar Township - Fayette County
Dunkard Township - Greene County
East Cocalico Township - Lancaster County
East Hanover Township - Lebanon County
East Marlboro Township - Chester County
East Taylor Township - Cambria County
Earl Township - Lancaster County
East Bethlehem Township - Washington County
East Huntingdon Township - Westmoreland County
Fallowfield Township - Washington County
Franklin Township - Fayette County
Franklin Township - Greene County
Georges Township - Fayette County
German Township - Fayette County
Green Township - Indiana County
Harris Township - Centre County
Hegins Township - Schuykill County
Hopewell Township - York County

TOWNS AND TOWNSHIPS (continued)

Pennsylvania (continued)

Jefferson Township - Butler County
Jefferson Township - Lackawanna County
Lower Chichester Township - Delensee County
Lackawannock Township - Mercer County
Leacock Township - Lancaster County
Lehman Township - Luzerne County
Lower Alsace Township - Berks County
Lower Towamensing Township - Carbon County
Lower Yoder Township - Cambria County
Luzerne Township - Fayette County
Maxatawny Township - Berks County
Menallen Township - Fayette County
Millcreek Township - Erie County
Mount Carmel Township - Northumberland County
Mount Pleasant Township - Washington County
Mount Pleasant Township - Westmoreland County
New Garden Township - Chester County
Oakland Township - Butler County
Paradise Township - Lancaster County
Penn Township - Butler County
Penn Township - Lancaster County
Peery Township - Fayette County
Plainfield Township - Northampton County
Quincy Township - Franklin County
Redstone Township - Fayette County
Rush Township - Centre County
Rush Township - Schuylkill County
Salisbury Township - Lancaster County
Saltlick Township - Fayette County
Shade Township - Somerset County
Shippensburg - Cumberland County
Shrewsbury - York County
Smith Township - Washington County
Snyder Township - Blair County
Springfield Township - Erie County
Springfield Township - Fayette County
Springhill Township - Fayette County
Stowe Township - Allegheny County
Straban Township - Adams County
Strasburg Township - Lancaster County
Summerhill Township - Cambria County
Summit Township - Somerset County
Susquehanna Township - Cambria County

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TOWNS AND TOWNSHIPS (continued)

Pennsylvania (continued)

Tinicum Township - Bucks County
Tinicum Township - Delaware County
Union Township - Mifflin County
Upper Augusta Township - Northumberland County
Upper Nazareth Township - Northampton County
West Earl Township - Lancaster County
West Mead Township - Crawford County
Warwick Township - Bucks County
Westtown Township - Chester County
Wilmington Township - Lawrence County

Rhode Island

Jamestown Town - Newport County

Vermont
Brandon Town - Rutland County
Brattleboro Town - Windham County
Essex Town - Chittenden County
Fair Haven Town - Rutland County
Hinesburg Town - Chittenden County
Jericho Town - Chittenden County
Shaftsbury Town - Bennington County
Swanton Town - Franklin County

RESERVE FUNDING

The fiscal 1984 HUD Appropriations Act included $1.5 billion in a reserve fund until passage of further legislation or March 31, 1984.

Question: Have you allocated any of those funds? When and under what circumstances do you intend to do so?

Answer: We received on May 17, 1984, an approved apportionment from OMB which makes the $1.5 billion available but as yet, none of the $1.5 billion has been allocated to the field. Several issues must be resolved before the funds can be made available to the field. The Department is proposing a reprogramming of some funds and will continue to review the recapture situation since recaptured authority is to be used for assistance for Section 202 projects.

Question: If Congress is unable to pass H.J. Resolution 517 or comparable legislation, how do you intend to proceed?

Answer: In general, the Department will follow the intent of Congress as reflected in the report language for H. J. Resolution 517. However, we need legislation to fund the full 56,000 units of existing housing, the higher level of modernization, higher voucher fees and the transfer of budget authority for rental rehabilitation and rental development grants. Therefore, we cannot proceed to implement all of the proposals until enactment of the pending bill.

Question: Once H.J. Resolution 517 or comparable legislation is enacted, when would final regulations be available for: the voucher program, rental rehabilitation grants, and rental development grants?

Answer: The Voucher Demonstration program is to be published as a Notice of Funding Availability (NOFA) in the Federal Register. If the Voucher program becomes permanent, the Department may use the NOFA as the basis for rulemaking. The draft NOFA was transmitted to the Office of Management and Budget on May 14, 1984. We cannot pinpoint a date at this time, however, we anticipate publication in the near future.

Regulations for the Rental Rehabilitation Grants Program became effective on May 24, 1984.

HUD expects to publish interim regulations for the Housing Development Grants Program on or about June 6, 1984, with a projected effective date of July 30, 1984. Publishing the regulations for effect on an interim basis should permit HUD to implement the program during FY 1984. Public comments will be solicited on the interim rule and will be considered before a final rule is issued (probably in late 1984 or early 1985).

Question: How soon after enactment could actual funding be made available to eligible communities?

Answer: Funds could be made available to the Field Offices within weeks of enactment of Appropriation legislation. However, availability to eligible applicants is contingent upon program implementation in accordance with the schedule outlined in the response to the previous question.

INTEREST RATES

Question: What are your current projections for the remainder of the year on interest rates?

Answer: It is currently projected that the conventional interest rates for FY 1984 will average 13.1 percent.

Question: What are you now anticipating in terms of interest rates during fiscal year 1985?

Answer: For FY 1985, the Department is projecting an average of 13.52 percent.

Question: To what extent are mortgage instruments other than long-term fixed rate ones being utilized?

Answer: During the first five months of FY 1984, approximately 60 percent of the conventional mortgage loans were adjustable rate mortgages.

SECTION 202

Question: How many Section 202 units will actually be funded with the fiscal 1984 appropriation?

Answer: The Department has allocated funds to the field offices to provide for 14,362 additional units for 1984.

Question: If there were no limitation in statute on the Section 202 interest rate (current limit is 9.25 percent), what would the rate for the current year be?

Answer: The interest rate for the current year would be 10.75 percent.

Question: If there were no limit on the interest rate for FY 84, how many units would you expect to fund?

Answer: From the Section 202 funding perspective, the interest rate would have no effect on the initial funding of reservations since the final interest rate on those loans would not be known until initial closing which could be up to 18 months after the funding approval. If the interest rate is higher at initial closing than at preliminary stages of processing (e.g., conditional commitment), a determination would have to be made as to the capability of the sponsor to qualify. In retrospect, fewer units could result from the funding year, but that would not be known until the initial closing prior to construction start. In addition, any increase in interest rates could necessitate an increase in amendment needs, and therefore, ultimately result in fewer units.

In addition, from the Section 8 funding perspective, an increase in the Section 202 interest rate would reduce the number of units reserved in 1984 since any Section 202 amendments require a corresponding Section 8 amendment. The Section 8 amendment funding would reduce that year's available authority for the new Section 202 reservations.

Question: If there is no statutory limit on the fiscal 1985 interest rate, what would you expect that rate to be?

Answer: We estimate the interest rate for 1985 to be 10.3 percent.

SECTION 235

Question: Why aren't you requesting any further funding for the restructured Section 235 program?

Answer: It had been determined that in a tight budget, scarce resources should be devoted to providing rental assistance to those most in need of Federal subsidy (very low-income-families) rather than be used to subsidize homeownership. This subsidy assistance to homeowners is an inefficient and inequitable use of scare Federal resources.

Also, the Department's subsidized housing strategy for fiscal year 1935 emphasizes subsidies for existing housing. The Section 235 program is primarily a new construction program, with few substantially rehabilitated units.

Depending upon when the new regulations could be put in place, the implementation of this restructured program could have an impact on Federal outlays as early as fiscal year 1984 or the beginning of 1985. We could not implement the program and restrict Federal outlays as we must.

Question: If $167 million is appropriated in FY 84 to restart the program, how soon could you restart the program following enactment?

Answer: We estimate that it would take 3 to 6 months to make revisions to the program regulations, before the program could be implemented.

MORTGAGE REVENUE BONDS

Question: In its evaluation of housing needs and its proposals, have you factored in possible extension of mortgage revenue bond authority?

Answer: The Department has not factored in the possible extension of mortgage revenue bond authority because of the low volume of insurance written generated by the bonds. During calendar year 1983, mortgage revenue bonds supported only $5.7 billion or 2.5% of the total single family mortgage financing. Applying this percentage to the volume of FHA insurance written during FY 1983 results in $558 million.

Question: If a mortgage revenue bond authority is extended, would you expect any major impact on HUD programs or requests?

Answer: The Department would expect no major impact on HUD programs or requests if the mortgage revenue bond authority is extended. Single-family mortgage insurance application estimates may be slightly affected, since they were based on an estimate of total loan originations - from all sources - with an estimated FHA percentage share of the market. However, single family mortgage insurance applications generated through use of mortgage revenue bonds represents only a small portion of the total mortgage insurance activity.

RURAL AREAS

Question: What portion of HUD's FY 1984 budget will be spent in rural areas?

Answer: HUD is required statutorily to allocate to "nonentitlement" areas a certain portion of its Community Developm Block Grant (CDBG) program funds. Nonentitlement areas are define as those areas which are not a metropolitan city or urban county. Essentially, nonentitlement areas include communities which are located in rural areas although small cities, within metropolitan areas, are also eligible for block grant assistance. State governments are responsible, in most cases, for the administration of the CDBG nonentitlement program, including selection of communities. In 1984, an estimated $1,063.6 million is expected to be obligated under the CDBG nonentitlement program.

Under the Urban Development Action Grants (UDAG) program, there is also a statutory requirement that 25 percent of the program's funds be allocated to small cities of less than 50,000 population. These communities may be located in either urban or rural areas. In 1984, an estimated $268.4 million of UDAG funds will be available for obligation to small cities.

Section 8 and Public Housing are not affected by statutory mandates to make a specific amount of funding available to rural areas in 1984. Therefore, the Department cannot state with any certainty, for these programs, how much will be provided to rural areas. However, based on prior experience, it can be assumed that approximately 20 to 25 percent of the remaining program funds will be available to rural areas.

Question: Do you believe HUD has an obligation to spend a specified portion of its budget in rural areas?

Answer: Yes. The Department does believe it has a responsibility to serve the housing and community development needs of rural (non-metropolitan) areas and the Department is aware that it is important that rural areas benefit from its programs. Toward that goal, the Department's programs are structured to encourage rural participation.

Question: What is your definition of a rural area?

Answer: "Rural" as used by the Department of Housing and Urban Development is defined, generally, to include all non-metropolitan (non-MSA) areas of the country.

Question: Has HUD discussed with OMB any requirements--statutory or otherwise--regarding funding for rural areas?

Answer: Yes, there have been periodic discussions between HUD and OMB staffs concerning the allocations of various programs to rural areas.

GNMA AND FHA LIMITATIONS

Question: How much of the GNMA and FHA authority will be utilized in FY 1984?

Answer: Based on current market conditions, we estimate that between $53 billion and $60 billion of GNMA MBS commitment authority will be utilized in FY 1984, as well as approximately $30 billion of the $50.9 billion ceiling for FHA insurance commitments.

Question: Do you have any objection to a provision requiring notice to Congress should requirements approach these limits?

Answer: The Department would not have any objections to providing Congress notice should the limits be approached. Report language in prior years has directed that this be done and the Department has complied.

COMMUNITY DEVELOPMENT BLOCK GRANTS

Question: How many communities will realize a reduction of 10 percent or more in the FY 1984 and FY 1985 allocations as a result of the use of data from the 1980 census and the increase in the number of eligible communities from 735 in FY 1983 to 795 in FY 1984 to a projected 810 in FY 1985?

Answer: There are 130 communities which will realize a reduction of 10 percent or more in allocation between FY 1983 and FY 1984. These reductions are principally due to the use of 1980 census data for the housing factors in the CDBG formulas and to the increase in entitlements of 54 new metropolitan cities and six new urban counties.

While we do not have an estimate of FY 1985 allocations for each community at this time, it is likely that no communities will realize a reduction of 10 percent or more. For the FY 1985 allocations, we expect to make only a relatively minor update to the population factors in the CDBG formulas (in the use of 1982 population estimates rather than 1980 population census counts) and we are expecting an increase in entitlements of only 15 communities.

Question: Please list the communities and give the percentage of reduction in each.

Answer: Below are listed the 130 communities which will realize a reduction of 10 percent or more in allocation between FY 1983 and FY 1984. The reduction does not reflect an increase of funds which many communties received in FY 1983 and FY 1984 due to a reallocation of prior year funds.

Community	Percent Reduction
Florissant, MO	-34.14%
Bloomington, MN	-29.00%
Livonia, MI	-27.17%
Norton Shores, MI	-26.05%
Roseville, MI	-25.69%
Anoka County, MN	-24.16%
St. Clair Shores, MI	-22.92%
Moorhead, MN	-22.80%
Sayreville, NJ	-22.50%
Bristol Township, PA	-21.88%
Enid, OK	-21.59%
Waterford Township, MI	-20.93%
Oak Lawn, IL	-20.83%
Warren, MI	-20.70%
Parma, OH	-20.64%
Hennepin County, MN	-20.55%
Lake County, IN	-20.26%
Bismarck, ND	-20.13%

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Community	Percent Reduction
St. Cloud, MN	-20.00%
Wyoming, MI	-19.84%
Portage, MI	-19.59%
Summit County, OH	-19.47%
Penn Hills Township, PA	-18.95%
Grand Forks, ND	-18.95%
West Seneca Town, NY	-18.69%
Hamilton County, OH	-18.60%
St. Louis County, MO	-17.99%
St. Clair County, IL	-17.96%
Wayne County, MI	-17.88%
Cheektowaga Town, NY	-17.86%
Woodbridge, NJ	-17.77%
Kettering, OH	-17.56%
East Hartford, CT	-17.46%
Milwaukee County, WI	-17.45%
Rapid City, SD	-17.01%
Stark County, OH	-16.94%
Taylor, MI	-16.77%
Jefferson County, KY	-16.65%
Middletown, NJ	-16.56%
East Orange, NJ	-16.53%
Franklin County, OH	-16.44%
Genesee County, MI	-16.30%
Macomb County, MI	-16.21%
Billings. MT	-15.98%
Montgomery County, OH	-15.85%
Pueblo, CO	-15.84%
Madison, WI	-15.20%
Green Bay, WI	-15.19%
Greece Town, NY	-15.00%
Oakland County, MI	-14.90%
Hickory, NC	-14.56%
Onondaga County, NY	-14.56%
Middletown, OH	-14.55%
Independence, MO	-14.54%
Lorain, OH	-14.53%
Arlington Hts., IL	-14.46%
Farmington Hills, MI	-14.29%
Kansas City, KS	-14.18%
Edison Township, NJ	-13.96%
Gary, IN	-13.89%
Middlesex County, NJ	-13.73%
Lake County, IL	-13.62%
Kent County, MI	-13.43%
Anne Arundel County, MD	-13.24%
Will County, IL	-13.22%
Cuyahoga County, OH	-13.10%
Bucks County, PA	-13.08%
Baltimore County, MD	-13.08%
Colonial Heights, VA	-13.01%
High Point, NC	-13.00%
East St. Louis, IL	-12.93%
Hopewell, VA	-12.92%
Colonie Town, NY	-12.83%

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Community	Percent Reduction
Cedar Falls, IA	-12.79%
Owensboro, KY	-12.73%
Du Page County, IL	-12.70%
Benton Harbor, MI	-12.64%
Des Plaines, IL	-12.50%
Burlington, NC	-12.38%
Gulfport, MS	-12.37%
Elyria, OH	-12.32%
Overland Park, KS	-12.30%
Pensacola, FL	-12.06%
Joplin, MO	-11.94%
Redondo Beach, CA	-11.89%
Monroe County, NY	-11.84%
Fayetteville, NC	-11.82%
Jefferson County, AL	-11.77%
Gastonia, NC	-11.75%
Midwest City, OK	-11.72%
Warwick, RI	-11.66%
Stamford, CT	-11.64%
Pontiac, MI	-11.63%
Boise, ID	-11.60%
Spartanburg, SC	-11.59%
Denison, TX	-11.57%
Bristol, TN	-11.54%
Irvington, NJ	-11.52%
Beaumont, TX	-11.49%
Hartford, CT	-11.46%
Lake Charles, LA	-11.44%
Lynchburg, VA	-11.36%
Old Bridge Township, NJ	-11.36%
Hampton, VA	-11.24%
Rockford, IL	-11.17%
Scottsdale, AZ	-10.97%
Parsippany-Troyhills, NJ	-10.91%
Orange, TX	-10.90%
Madison County, IL	-10.84%
North Little Rock, AR	-10.82%
Iowa City, IA	-10.68%
Sherman, TX	-10.57%
Sioux Falls, SD	-10.54%
Cook County, IL	-10.51%
Texarkana, AR	-10.44%
Casper, WY	-10.37%
Roanoke, VA	-10.36%
Rochester, MN	-10.36%
Mobile, AL	-10.27%
Newark, NJ	-10.26%
Cedar Rapids, IA	-10.17%
Omaha, NE	-10.16%
Columbus, GA	-10.15%
Lincoln, NE	-10.12%
Babylon Town, NY	-10.10%
Anderson, IN	-10.08%
Petersburg, VA	-10.06%
Kingsport, TN	-10.02%
Kansas City, MO	-10.01%
Topeka, KS	-10.01%

Question: How much would be necessary in order to freeze all payments at the FY 1983 level and add the new communities?

Answer: Since we cannot calculate FY 1985 allocations at this time, we can only give a rough estimate of the amount necessary to "freeze" FY 1985 payments at no less than FY 1983 levels. FY 1985 allocations can only be calculated after the Department identifies all new entitlement communities, determines the participation of small cities with urban counties and has 1982 population estimates in place.

An approximation of the amount necessary to "freeze" FY 1985 entitlement amounts at no less than FY 1983 levels would be an additional $112.6 million over the FY 1984 allocation of $2,379.9 million. The $112.6 million estimate includes $102.4 million to cover the aggregate allocation loss which was experienced by entitlement communities between FY 1983 and FY 1984 and $10.2 million for an estimated increase of 15 entitlement communities.

The current statutory provisions do not provide a mechanism for "freezing" entitlement at FY 1983 levels for entitlement communities which have lost funding in FY 1984. If an additional $112.6 million were merely added to the part of the appropriation available to entitlement communities--without a statutory mechanism to freeze entitlements--then the additional money would be spread among entitlement communities which both gained and lost allocation in FY 1984.

JOBS BILL

Question: Has all the $1 billion funding made available through the emergency jobs legislation been obligated?

Answer: As of April 30, 1984, $997.7 million of the $1 billion Jobs Bill appropriation had been obligated.

Question: What portion has been expended?

Answer: As of April 30, 1984, $265.7 million of the Jobs Bill appropriation had been expended.

SECTION 108

Question: To what extent (number of loans and amount) was the Section 108 program utilized in FY 1983 and FY 1984 to date?

Answer: In FY 1983, 22 loan guarantee commitments were approved for a total of $60,626,592. As of March 31, 1984, $19,166,900 has been reserved for 11 loan guarantee commitments. Of this amount, 7 loan guarantee commitments have been approved for a total of $17,026,900.

Question: What is the justification for terminating it?

Answer: This program has been proposed to be discontinued at the end of FY 1984 in accordance with the Administration's desire to alleviate market pressures caused by excessive Federal borrowing.

BLOCK GRANTS

Question: How many communities have had their CDBG grants reduced or conditioned as a result of noncompliance or program mismanagement in FY 1983 and FY 1984 to date?

Answer: The FY 1983 grants of 9 communities were reduced and 14 were conditioned. The Jobs Bill grants of 7 communities made during 1983 were also conditioned.

So far no FY 1984 grants have been reduced, and only 1 community has had its FY 1984 grant conditioned.

CDBG REGULATIONS

Question: Have all CDBG regulations necessitated by passage of the 1983 Housing and Urban-Rural Recovery Act been issued? If not, what is the timetable?

Answer: States Program -- On February 17, 1984, the Department issued instructions to the States on how to implement the legislation pending formulation and publication of a formal regulation (rule). The instructions were based on the statute and linked to existing regulatory requirements for entitlement cities, except where such regulations were amended by the 1983 legislation. This approach will enable us to implement these statutory changes with the 1984 States program. We anticipate issuing a proposed rule to implement the legislation in late June for public comment, to be followed by a final rule.

Entitlement Program — On February 3, 1984, the Department issued instructions to entitlement grantees, under which entitlement grantees are able to receive and use their CDBG funds pending the promulgation of a formal regulation (rule) implementing the 1983 amendments. These interim instructions guide the grantees in using the existing program regulations, together with the 1983 statutory amendments, so as to ensure that program requirements are met.

Current plans are that proposed change to the regulations will be published before August for public comment. The final rule will probably not be issued until next year, owing largely to the expected Congressional adjourment late this summer.

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SECRETARY'S DISCRETIONARY FUND

Question: Please provide a list, with amounts involved, of projects and activities funded from the Secretary's Discretionary Fund in fiscal 1984.

Answer: The list of projects is in two parts: part I lists all fiscal year 1984 Secretary's Discretionary Fund obligations; part II lists the Technical Assistance projects approved for funding by the Secretary for which funds have been reserved but not obligated.

I. Secretary's Discretionary Fund Obligations of FY 1984 Funds

Dept. of Interior Interagency Agreement	$65,000
One America	173,145
Minority Business Development Agency Interagency Agreement	234,000
One America	529,682
Dallas Merrell	9,973
Dept. of Commerce Interagency Agreement	25,000
National Assn. of Towns & Townships	409,094
Council of State Community Affairs Agencies	299,439
Campbellsville, KY	15,000
Holland, MI	15,000
Lewiston, ME	73,585
U.S. Conference of Mayors	171,000
Economic Development Administration Interagency Agreement	500,000
Council for Urban Economic Development	200,000
National Assn. of Neighborhoods	250,000
National Community Development Association	127,2[illegible]5

State Technical Assistance:

Nevada	75,000
South Carolina	148,000
North Carolina	175,000
Mississippi	175,000
Missouri	149,000

II. Technical Assistance Projects Approved by the Secretary for Funding in Fiscal Year 1984: Awards Currently in Process

Dept. of Interior Interagency Agreement	$200,000
City of Columbia, SC	120,000
Coalition of Northest Municipalities	275,000
CD Work Study Program	2,250,000
New York City	75,000
Northwest Economic Action Council	116,000
Howard University	250,000
State of Utah	500,000

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Council of State Community Affairs Agencies	141,609
South Bronx RFP	1,300,000
National Governors Assn.	233,000
Historically Black Colleges & Univ.	1,500,000
Waste to Energy Project	150,000
City of Los Angeles	101,244
RFP on Improving State CDBG Fund Disbursement	100,000
RFP: TA to States on Audit Requirements	150,000
District Heating Competition - Phase II, Round III	350,000
National Citizen Participation Council	235,000
Washington Consulting Group	360,000
National Urban League	200,000
City of Macon, Georgia	30,000
State Technical Assistance	2,600,000
Neighborhood Development Program	2,000,000
Rental Rehab Technical Assistance	1,000,000

Question: Are there any remaining unobligated balances for fiscal 1984?

Answer: The Indian and Insular Areas FY 1984 CDBG funds in the Secretary's Discretionary Fund have not been obligated as of April 30, 1984. At the present time competitions for Indian funding are underway across the country. Actual funding will begin in mid-May and run through September 30, 1984. The Insular Area applicants have all received tentative fund allocations and are preparing applications for funding. This funding will be completed by September 30, 1984.

The Technical Assistance program has $19,558,270 in unobligated funds. Award documents for projects which have been approved by the Secretary, totaling $14,236,853, currently are being processed. Projects totaling more than $2 million have been recommended to the Secretary for approval and are awaiting final decisions. It is expected that all remaining TA funds will be obligated by September 30, 1984.

Question: You note that "technical assistance" is the principal type of activity funded by the Secretary's Discretionary Fund. How would you characterize the other main types of categories?

Answer: The two other categories in the Secretary's Discretionary Fund are the Indians and Insular Area Community Development Block Grant programs. Both of these programs fund the same kinds of activities that are undertaken by small and large cities under the basic CDBG program. For FY 1984, the Indian CDBG program allocation is $39.7 million. The Insular Area CDBG program allocation for fiscal year 1984 is $5.95 million.

Question: Are there pending requests for assistance which you anticipate funding from the Fiscal Year 1985 request?

Answer: No, requests for 1985 assistance will be solicited in FY 1985, subject to the availability of funds.

Question: Are requests made now automatically held for possible 1985 funding?

Answer: No, the Department does not anticipate holding requests over to 1985.

URBAN DEVELOPMENT ACTION GRANTS

Question: How many small cities participated in the UDAG program in FY 83? FY 84?

Answer. 205 small cities participated in the UDAG program in FY 1983. Through May 1984, 133 small cities have participated in FY 1984.

Question: A March 5 GAO report found that many of the most economically distressed small cities did not participate because they were unfamiliar with the program, they had insufficient planning capacity or they had difficulty obtaining adequate private sector involvement. These problems are not new, but HUD is supposed to be addressing them through technical assistance programs. What is HUD actually doing to overcome these problems?

Answer: The UDAG office has under contract four national technical assistance providers who have at least some part of their work program aimed at assisting small cities to package UDAGs. These are:

(1) National Development Council (NDC). This group administers for the Department the small business economic revitalization effort funded with CDBG technical assistance funds. A significant element under this program is to train local economic development professionals in 30 states to be able to identify and package UDAG projects, especially small city projects.

(2) Halcyon. This organization is the UDAG master contractor. The objective of the contract is to use the expertise of a multi-disciplined team to assist distressed cities plan and package fundable UDAG projects and to work with cities who have trouble implementing a project after they receive preliminary approval of a grant. Since many more small cities have a difficult time in all phases of the UDAG program than large cities, a large percentage of Halcyon's time is spent on assisting these small cities.

(3) National Association of State Development Agencies (NASDA). The purpose of this contract is to assist eight states to improve their ability to help local governments use CDBG and UDAG funds for economic development, in ways that compliment the use of other state resources and maximize the private dollars leveraged by a project. As part of this effort, NASDA will provide technical assistance to eight states using direct peer-to-peer development, especially in small cities.

(4) McManus Associates. The purpose of this contract is to provide workshops and seminars for small cities to explain the UDAG program and follow-up with direct technical assistance on site.

In addition to these four contracts, UDAG field staff encourages and participates in State-sponsored conferences to explain and promote the use of the UDAG program. For example, the States of Arkansas, Maryland, Missouri, Kansas, Massachusetts, Ohio, Florida, Idaho, Michigan, Minnesota, Maine, Louisiana, Georgia, New York, Delaware, Pennsylvania and Oregon have all held such conferences. An aggressive technical assistance effort has been mounted for small cities and it is paying off.

Question: What are the unobligated balances in the small cities program?

Answer: The following table indicates the unobligated balances for the UDAG small cities program for fiscal years 1983, 1984, and 1985:

ACTUAL 1983	ESTIMATE 1984 (Dollars in Millions)	ESTIMATE 1985
$133.3	$25.0	...

RENTAL REHABILITATION GRANTS

Question: Reports indicate that New York City will receive more than 10 percent of the $150 million anticipated for rental rehabilitation grants. Is this correct?

Answer: Yes, the formula allocation for New York City is $15,853,500.

Question: Can you justify having more than 10 percent of the available funds go to one city?

Answer: We believe that the formula for allocating the funds directs those funds in proportion to the need for assistance -- the greater the need, the higher the allocation. Since the allocation is directly related to need, we feel we can justify the allocation amounts the formula yields. The allocations are based on objective statistical data according to the incidence of substandard rental housing occupied by low-income renters.

Question: How many of the 421 qualified communities will receive only the minimum amount of $50,000?

Answer: There are 37 localities which will receive between $50,000 and $60,000. The following table indicates a range of dollars and the number of localities that would receive grants by size of grant. The median grant amount is $119,700.

Grant Amount	Number of Localities
Under $60,000	---- 37
$60,000-$75,000	---- 63
$75,100-$100,000	---- 70
$100,100-$150,000	---- 99
$150,100-$300,000	---- 85
$300,100-$500,000	---- 28
$500,100-$1,000,000	---- 27
Over $1,000,000	---- 12
Total Localities	----421

Question: How large a program could be run with a $50,000 grant?

Answer: We would expect with a $50,000 grant, a community would be able to rehabilitate between 10 and 15 properties. It would depend, of course, on the amount of subsidy needed per unit.

SECTION 312

Question. To what extent do properties that qualify for Section 2 assistance also qualify for rental rehabilitation grants?

Answer: Rental Rehabilitation Grants are available for use on ntal units only. The majority of Section 312 loans are made to mers who occupy single family properties. The program definition single family property is a residential structure with 1 to 4 elling units. An owner of such a structure could conceivably alify for either program for the rehabilitation of units which are ed as rental units. Units occupied by owners, including a large mber of structures which contain only one unit, would qualify only r the Section 312 program.

Question: To what extent are recipients the same under 312 and ntal Rehabilitation Grants?

Answer: If "recipient" is meant to be a locality applying for rticipation in either program, recipients may be eligible for rticipation in both programs in many instances. If recipients are operty owners seeking rehabilitation assistance, it is possible at such a recipient could benefit from both Section 312 and Rental habilitation Grant funds for property rehabilitation. However, the partment has proposed that the Section 312 program be terminated as separate rehabilitation loan program.

Question. How much do you anticipate in repayments under ction 312 in FY 1985?

Answer: It is estimated that approximately $80 million in loan payments will be received in FY 1985, along with $10 million of an recoveries.

ANNUAL HOUSING SURVEY

Question: What areas are currently included in the American sing Survey?

Answer: The following table lists the 44 metropolitan area ples that will be surveyed under the AHS program in the years 4-1987. The thirty largest metropolitan areas are represented 35 samples, and samples in nine of the thirteen next largest ropolitan areas will also be surveyed. These areas include t over one-half of the nation's renters.

Senator Huddleston—Continued

American Housing Survey Metropolitan Statistical Area Samples

MSA	Previous year of interview	Sample size
1984		
Birmingham, Ala.	1980	4,250
Buffalo, N.Y.	1979	4,250
Cleveland, Ohio	1979	4,250
Indianapolis, Ind.	1980	4,250
Memphis, Tenn.-Ark.	1980	4,250
Milwaukee, Wis.	1979	4,250
Norfolk-Newport News, Va. CMSA	1978	4,250
Oklahoma City, Okla.	1980	4,250
Providence-Pawtucket-Warwick, R.I.-Mass.	1980	4,250
Salt Lake City-Ogden, Utah	1980	4,250
San Jose, Calif.	NA	4,250
1985		
Detroit, Mich.	1981	8,500
Los Angeles, Calif.	1980	8,500
Philadelphia, Pa.-N.J.	1982	8,500
Washington, D.C.-Md.-Va.	1981	8,500
San Francisco, Calif.	1982	8,500
Boston, Mass, CMSA	1981	4,250
Dallas, Tex.	1981	4,250
Ft. Worth, Tex.	1981	4,250
Minneapolis-St. Paul, Minn.	1981	4,250
Phoenix, Ariz.	1981	4,250
Tampa-St. Petersburg, Fla.	NA	4,250
1986		
Anaheim-Santa Ana-Garden Grove, Calif.	1981	4,250
Cincinnati, Ohio-Ky.-Ind.	1982	4,250
Denver, Colo.	1983	4,250
Kansas City, Mo.-Kans.	1982	4,250
Miami-Ft. Lauderdale, Fla. CMSA	1983	4,250
New Orleans, La.	1982	4,250
Pittsburgh, Pa.	1981	4,250
Portland, Ore.-Wash.	1983	4,250
Rochester, N.Y.	1982	4,250
San Antonio, Tex.	1982	4,250
Riverside-San Bernadino, Calif.	1982	4,250
1987		
Atlanta, Ga.	1982	8,500
Chicago, Ill.	1983	8,500
New York (incl. Nassau-Suffolk), N.Y.	1983	8,500
Columbus, Ohio	1982	4,250

Senator Huddleston—Continued

MSA	Previous year of interview	Sample size
Baltimore, Md.	1983	4,250
Hartford, Conn. CMSA	1983	4,250
Houston, Tex.	1983	4,250
Northeastern N.J.	1981	4,250
St. Louis, Mo.-Ill. CMSA	1983	4,250
Seattle-Tacoma, Wash. CMSA	1983	4,250
San Diego, Calif.	1982	4,250

Question: I understand that 14 areas were dropped from the annual housing survey in 1982. Please list the areas and their population.

Answer: Fourteen (14) metropolitan areas were dropped from the survey in 1982. In addition, surveys of two areas (Colorado Springs, Colorado and Springfield, Mass.) were "postponed" in 1982 and have subsequently been dropped for a total of 16 areas.

A thorough reassessment in 1982 of HUD's data needs and priorities, in view of budget constraints, concluded that only 44 samples in metropolitan areas could be surveyed over the period 1984-87, and that further cuts should be made after 1987 as necessary to remain within a fixed budget. Consequently, 16 areas (including Colorado Springs and Springfield) are no longer being sampled. These areas and their 1980 populations are as follows:

MSA	1980 population (in 000s)
Albany-Schnectady-Troy, NY	836
Allentown-Bethlehem-Easton, PA	635
Colorado Springs, CO	309
Grand Rapids, MI	602
Honolulu, HI	763
Las Vegas, NE	463
Louisville, KY-IN	957
Madison, WI	324
Omaha, NB	585
Orlando, FL	700
Raleigh, NC	561
Sacramento, CA	1,100
Saginaw, MI	422
Spokane, WA	342
Springfield-Chicopee-Holyoke, MA	515
Wichita, KS	411

Question: How were the 14 areas to be dropped selected?

Answer: The paramount consideration in deciding which metropolitan areas to continue to survey was to maximize the population and number of renters that could be represented by the available sample cases. This consideration dictated that the largest 30 or so metropolitan areas previously included should be retained and the smallest SMSAs dropped. Thirtyfive samples representing the 30 largest metropolitan areas were accordingly retained while 16 samples covering the MSAs with 1980 population below 850,000 were excluded on the basis of their smaller populations.

Question: In 1983 Louisville, Honolulu and Sacramento were surveyed because they were being dropped. How many units were surveyed/sampled in each city?

Answer: Approximately 4,250 housing units each were surveyed in Louisville, Honolulu and Sacramento in 1983.

Question: Are samples being reduced? If so, according to what time table?

Answer: Because of budget constraints, both the national and metropolitan area samples are being reduced in size. Prior to 1981, 60 SMSAs were surveyed by the AHS over a 4-year rotation period, with approximately 16,000 cases included in each of 12 "large-sample" SMSAs and 6,000 cases surveyed in the remaining 48 areas. SMSA sample sizes were first reduced incrementally among the SMSAs surveyed in 1981. Beginning in 1984, there will be approximately 8,500 cases in each of 8 samples and 4,250 cases in the remaining 36 samples surveyed over a 4-year period.

Question: What is the per unit cost of a sample?

Answer: The current cost per interview includes field costs (materials preparation, travel and interviewing, and initial data processing) of $52 in metro areas and $55 for the national survey. In addition, survey management and overhead (planning, establishing and maintaining the samples, computer programming and data processing, publishing and dissemination, and management of these activities) adds about $38 per interview for a total of $90 to $93 per interview in current dollars. However, expanding samples in current surveys, or even adding samples in additional metro areas, would not require $90 per interview because the overhead costs are already basically covered by the current surveys. Additional metro area samples, for example, would only require $52 per interview for field costs plus about $3 for marginal increases in survey processing costs, or about $55 per interview.

Question: What is the actual request for the housing survey in FY 1985? Please be specific.

Answer: For fiscal year 1985, the Budget requests $10 million for the American Housing Survey. This amount will be obligated for two basic purposes: (1) to fund a portion of the 1984/1985 survey, and (2) to fund a portion of the 1985/1986 survey. The precise allocation of the $10 million between the two surveys cannot be determined at this time.

HOUSING ASSISTANCE COUNCIL

Question: Why is there no request for funding for the Housing Assistance Council (HAC)?

Answer: Neither the Department's Research and Technology nor Salaries and Expenses appropriation requests include set-asides to meet the on-going operational costs of any groups in 1985. We do not believe such set-asides to be an appropriate use of either limited research or limited administrative expense funds. Rather, the Department believes it more appropriate to fund specific research, program evaluation, and other requirements. For 1985, high priority research will include implementation of the many evaluations called for by the Housing and Urban-Rural Recovery Act of 1983. In addition, the 1985 research appropriation will be used to continue on-going housing research and the American Housing Survey.

Question: Have you found funding of HAC through the S&E account preferable to funding through PD&R (research and technology account)?

Answer: The Department does not advocate a funding set-aside for the Housing Assistance Council in either the Salaries and Expenses or the Research accounts. While funding through "Salaries and Expenses" is least desirable, neither is preferable as the continued operational support of the Council is not integral to the mission of this Department. If the Congress determines that such assistance is necessary, consideration should be given to providing it within the Department of Agriculture's appropriation bill since that Department's work pertains mostly to rural areas.

FAIR HOUSING

Question: What is the total cost of your current campaign to publicize the administration's support for the present Fair Housing Act?

Answer: The Department of Housing and Urban Development has not launched a campaign, as such, to publicize the Administration's support for the present Fair Housing Act. We are carrying out our responsibilities as contained in the current Act and various Executive Orders while stressing the need for stronger legislation. We cannot develop a dollar estimate that is geared toward publicity since we always endeavor to educate the public on the requirements and rights provided in the Fair Housing Law. This education occurs during our travels, when we respond to inquiries, on monitoring visits, during the provision of technical assistance to recipients, etc.

Additional funds are expended on printed informational materials which include fair housing brochures, equal opportunity logos, displays, posters, letters, and other educational items.

In recognition of the anniversary of the signing of the Civil Rights Act of 1968, a wide variety of educational activities were also sponsored by the Department during April.

In addition, pursuant to the statutory obligation of the Secretary to engage in "such educational...activities as in his judgment will futher the purposes of [Title VIII]," the National Campaign of Public/Private Partnerships for Fair Housing was initiated. The campaign was designed as an outreach effort relying almost wholly upon the private sector for funding. The cost to the Department of this activity is limited to staff time, travel, and graphic design.

Senator Huddleston—Continued

Question: Has HUD paid for the design and production of billboards, train and bus poster, newspaper and radio advertisements?

Answer: For Fair Housing Month 1984, the Department designed posters, flyers, and other graphics for newspaper advertisements, bus posters, and billboards. The Department also produced copy for Public Service Announcements. For the National Campaign for Public/Private Partnerships in Fair Housing, HUD designed the bus posters used in Baltimore, Maryland, and the design was revised for each subsequent city to include the name of the participating Mayor. The design for the billboards in Dallas, Texas, were derived from the bus poster. The billboards in New York City were derived from a poster prepared for Fair Housing Month. The cost of production of all materials and the airing of any radio advertisements, was borne by private sector groups. The Department did produce the copy for such advertisements.

Question: How many full page newspaper ads have been run--at what cost each? How many half page ones?

Answer: We are not aware of any full or half page newspaper ads that have been run in connection with any of the Department's fair housing outreach efforts.

In connection with the National Campaign of Public/Private Partnerships for Fair Housing, several 1/4 page ads were run in Dallas, Texas that were designed, produced, and paid for by private sector groups in that city. A 1/4 page advertisement was run in New York City and was also paid for by a private sector group.

I understand that HUD has solicited private funds to pay for much of the advertising.

Question: From whom were funds solicited (local developers, builders, realtors, etc.)?

Answer: HUD has requested the participation of the private sector in underwriting some of the cost of advertising the fair housing law. HUD sought private funds for the National Campaign of Public/Private Partnerships for Fair Housing from realtors, builders, developers, civil rights groups, private citizens, advertising companies, television and radio stations, Chambers of Commerce--as well as well-known celebrities who have donated their time and talents to promote fair housing.

Question How were funds solicited?

Answer: A member of the Secretary's Immediate Office has been coordinating the National Campaign for Public/Private Partnerships for Fair Housing. Coordination included meetings with interested groups in several cities as well as encouragement for the establishment of coalitions of parties who pledged their financial support.

Question: Were any mailing lists used to solicit funds--were they HUD lists or private ones?

Answer: No mailing lists were used.

Question: How much has been collected from private sources?

Answer: With regard to the National Campaign of Public/Private Partnerships for Fair Housing, approximately $23,000 has been raised. This does not, however, include donated time, talent and advertising space.

Question: How are these funds being managed and used?

Answer: The funds are managed through the local coalitions participating in the National Campaign for Public/Private Partnerships for Fair Housing. Each local coalition pays the bills incurred in their localities. No funds are paid to HUD.

Question: What type of in-kind or service contributions have been solicited?

Answer: With regard to the National Campaign of Public/Private Partnerships for Fair Housing, many in-kind and service contributions have been donated. All space on radio, television, buses, billboards and newspapers were donated. Several companies also donated time, talent and personnel in each of the cities, so that all work could be done without calling on federal employees. Most services were in the field of Public Relations - such as talent and design.

In addition, the Department's general outreach activities, and particularly those conducted during Fair Housing Month, involved the solicitation of similar donations of in-kind or service contributions.

Question: Who financed the preparation of the advertisements that are going out in HUD mail?

Answer: The mailing cards were derived from the Department's Fair Housing Month poster--which the Department produces every year. The cards are not an advertisement, but a reminder that Fair Housing is the law. The cards also furnish the HUD discrimination hotline number which should be available to people who might need it or could pass it on to others. The cards were produced at the Department's expense as an element of its outreach activities.

Question: Who is paying the postage on the HUD mailings which are going out?

Answer: There are no mailings to distribute the HUD Fair Housing cards. The cards are simply included in routine outgoing mail.

Question: Please describe the outreach program you intend to conduct in FY 1985. What will the cost of that be?

Answer: We have discovered through our conversations with various groups, television interviews, complaints filed, etc. that the majority of people are unaware of Title VIII -- its requirements and remedies. Therefore, we are proposing an outreach program which will be educational in nature.

We recognize that different geographical areas have different Title VIII problems -- discrimination relative to race, sex, religion etc. Therefore, to reach the general public, we intend to request proposals from local fair housing and civil rights groups throughout the country. The proposals must indicate the materials and methods which will be used to educate the general public in a particular geographical area.

We are looking for innovative ways to reach and educate the public. Our preference is for proposals which will make an impact and which can be replicated. The cost of the outreach effort will depend on the nature of the proposals received.

Question: Even though your request for fair housing is up in FY 1985, aren't actual outlays projected to decline in FY 1985 from $11 million to $8.4 million as a result of reduced carryover balances? In what activities will this reduction in outlays occur?

Answer: Yes, outlays are estimated to decrease in 1985 as a result of less funds being available for obligation in 1985 as compared to 1984. Also, the Budget assumes 1984 obligations will occur early enough during the year to permit some outlays to occur during the same year. Prior to 1984, obligations occured, essentially, in September with the outlay impact delayed to succeeding fiscal years.

Further, a significant portion of the large unexpended balance of $12.4 million, at the end of 1983, is expected to be disbursed in 1984 leaving a balance of $6.1 million at the end of 1984. This reduction in the unexpended balance more than offsets the additional appropriation in 1985.

The reduction in 1985 outlays will occur mostly in the State and local agency component of the program.

HUD STAFFING

Question: Of the 517 full-time permanent employees who will be cut between 1983 and 1985, how many are in the field and how many in HUD headquarters?

Answer: The decrease of 517 full-time permanent (FTP) employees consists of reductions of 302 in headquarters and 215 in the field.

Question: Of the 517 employees, how many are from the housing programs and how many from community development?

Answer: Between 1983 and 1985, staffing for housing programs (including those administered by the Office of Public and Indian Housing) decreases by 327 FTPs. Staffing for Community Planning and Development increases by 63 FTPs.

Question: By year, how many full-time permanent employees have you RIFed since taking office?

Answer: A total of 371 full-time permanent employees have been separated from HUD since this Administration took office, 275 in FY 1983 and 96 in FY 1984 to date.

QUESTIONS SUBMITTED BY SENATOR LEAHY

Last year, Congress passed the new housing production program, Housing Development Action Grant program. I have become concerned about the steps HUD is taking to develop the eligibility list and what factors HUD is including to determine eligibility.

My concern is based on the questions I have been asked by the Mayor of Burlington, Vermont and by the Vermont Agency of Development and Community Affairs. Given the problems that both the federal agencies and small communities have historically had designing delivery systems to meet the needs of people living in small communities in rural areas, I understand why Mayor Sanders and the State officials are perplexed at the preliminary outcome of HUD's efforts to identify eligible communities.

I have attached the letters Mayor Sanders and Michael Richardson, Director of Community Develoment Operations for the State of Vermont, have sent me outlining their questions. I would appreciate HUD answering these and the following questions for me:

Question: What data is HUD using to determining the eligibility of small communities?

Answer: All data used to determine eligibility are from the 1980 or 1970 Decennial Census. The following eligibility measures are used:

1. Percent of families in poverty, 1980.
2. Percent of rental units in pre-1940 structures occupied by poverty households, 1980 (proxy for inadequate housing).
3. Percent overcrowding (more than one person per room), 1980.
4. Percent rental housing vacancies, 1980.

Question: What steps is HUD taking to identify those small communities which meet the statutory purpose and to incorporate the needs of these communities into the development of the eligibility criteria? the delivery system?

Answer: The eligibility criteria for all eligibility areas--large cities, small cities, towns and townships--adhere as closely as possible to the criteria stated in the Statute. The system developed from the statutory language directs the program to those areas that are "experiencing a severe shortage of decent rental housing opportunities for families and individuals without other reasonable and affordable housing alternatives in the private market." Each area, small or large, will be able to compete with every other area on an equal basis. Likewise, the delivery system (i.e., the application process) is also based on statutory language.

Question: Will eligible small communities have to compete against all applicants or will there be a "small communities" set-aside?

Answer: There is no provision in the Statute for a small community set-side. Smaller communities will be able to compete on an equal basis with larger communities. All applicants will be treated equally.

Response to Mayor Bernard Sanders of Burlington, Vermont

Question: Why was Burlington, Vermont excluded from the Rental Housing Development program eligibility list?

Answer: In developing the eligibility list, the statutory language was followed as closely as possible. The statute authorizes grants for new construction and substantial rehabilitation in areas that are "experiencing a severe shortage of decent rental housing opportunities for families and individuals without other reasonable and affordable housing alternatives in the private market." The statute also lists standards that reflect a severe housing shortage; poverty, inadequate housing; low vacancies; and high overcrowding. The statutory language and standards direct the grants to areas that not only have relatively poor quality rental housing and low-income tenants, but which also have tight market conditions that new construction and substantial rehabilitation may be able to alleviate.

A scoring system was developed in which 1980 Census data was applied to the statutory standards. A score of six out of a possible sixteen points was needed for eligibility. Burlington, Vermont received a score of five. Burlington scored low on the overcrowding factor and on the percent of families in poverty. Although Mayor Sanders states that 16.2 percent of the population is below the poverty level, HUD uses families in poverty, which we consider a better measure of housing needs. Burlington's family poverty rate was 7.8 percent in 1980. In addition, Burlington's vacancy rates in 1980 (3.8 percent vacancy rate; 1.6 percent vacancy rate over two months), were not high enough to overcome the poverty and overcrowding point losses.

Cities such as Burlington which are not designated eligible may still apply through the "special housing needs" provision. We recognize that general Census data may not pick up specific types of severe housing shortages or that housing market conditions may have changed since the 1980 Census. Therefore, applications will be accepted from non-designated areas that have a special renter group need (e.g., a need for large family housing) or have experience a rapid change or other dislocation in the housing market which has occurred since the taking of the 1980 Census (e.g., rapid population growth or a natural disaster). In addition, non-designated cities may apply through the neighborhood preservation provision. Proposed projects under this provision must be located in a neighborhood preservation area which meets certain standards and in which activities are already underway. The application package, now available at HUD Field Offices, will provide information on how the non-designated cities may apply for special needs and neighborhood preservation projects.

Response to Michael Richardson, Vermont Agency of Development and Community Affairs

Question: Why were so many less fortunate Vermont communities not found to be eligible?

Answer: In developing measures for the statutory eligibility factors, national, standardized census data were used that would best reflect a severe shortage of decent rental housing opportunities for a wide range of types and sizes of communities. For the "extent of poverty," the percent of families in poverty is used. "Inadequate housing" is measured by a proxy that HUD has found to be the best single measure of inadequate housing--rental units in pre-1940 structures occupied by poverty households. "Overcrowding" is measured by the percent of rental units with more than one person per room.

For the "level and duration of rental housing vacancies," we use both the percent of units vacant and percent of units vacant more than two months. No direct measure or adequate proxy was found for the "lag between need for and production of rental housing."

The final eligibility list now includes fourteen Vermont communities: Barre; Bellows Falls; Newport; St. Albans; Swanton; Winooski; and the towns of Brandon; Brattleboro; Essex; Fair Haven; Hinesburg; Jericho; Shaftsbury; and Swanton. Other communities may apply through the special housing needs or neighborhood preservation purpose as explained above in the response to Mayor Sanders' concerns.

Questions Submitted by Senator Sasser

URBAN DEVELOPMENT ACTION GRANTS (UDAG)

I have become increasingly concerned in recent weeks about the direction being taken in the development and implementation of eligibility criteria for the Urban Development Action Grant program.

You will recall the letter I cosigned with my colleagues in the Tennessee Congressional Delegation concerning UDAG eligibility criteria. We addressed the manner in which these criteria are used in the ranking of eligible projects.

Time and again during this Administration, the intent of Congress has been made clear with respect to our endorsement and support of the UDAG program. The heart of the cost-benefit analysis of the UDAG program is leveraging and jobs. Leveraging private capital through UDAG helps prevent the kind of recession that sends interest rates through the roof and increases federal budget deficits. Providing jobs through UDAG-assisted projects also takes people off government-backed assistance programs.

Because of these and other benefits of the UDAG program, Congress has reinstated UDAG funds proposed for cuts by the Administration. Now that these funds are in place, it is our further responsibility to insure that the funds are being allocated for the purposes intended by the program.

It is the intent of Congress, that the impaction and distress of cities applying for UDAG assistance be a fundamental part of ranking eligibility for limited UDAG funds. Those cities in the most serious circumstances should receive priority consideration.

The problem I have with your Department's procedures, however, is the virtutally absolute dependence on various housing and poverty statistics alone in establishing a rigid ranking system. A key point is that all applications, to be eligible, must represent constructive contributions, via the UDAG program, to very real and documented cases of distress; in other words, no city would be in the competition at all unless the need for assistance had been made clear.

Therefore it would seem to me to be a more logical, appropriate and fair use of the UDAG program to place reasonsable emphasis, within this group of fully-qualified applicants, on the quality and effectiveness of the solution proposed to their particular local program. The proper balance would allow the leveraging and job-creation aspects of UDAG an appropriate role in maintaining the quality and cost-effectiveness of the program.

You noted in your reply to the Tennessee Delegation of April 19, that the Department is also concerned about the weight given to certain criteria in establishing the selection system, and that Assistant Secretary Bollinger has a task force working on means to improve the system.

Question: Mr. Secretary, may I take this to mean that you and the Department anticipate making the changes I have recommended in my opening statement?

Answer: The Department is continuing to examine the selection system to identify modifications which can be made within the parameters of the Statute. As you know, Section 119(d) of the UDAG's legislation requires that the comparative degree of economic distress among applicant cities be used as the primary criterion for selecting applications for funding.

We agree with the importance of leveraging and employment impacts and these two factors are heavily emphasized in that part of the selection formula which relates to project-specific criteria. However, as mandated by the Statute, an areas's distress has more weight.

Question: What do you anticipate will be the ultimate costs to the UDAG program of failure to place adequate emphasis on the quality and cost-efficiency of the applications you receive?

Answer: From you previous question, it is assumed that you are relating quality and cost-effectiveness of applications to their ability to leverage private dollars and create permanent new jobs. It should be remembered that all UDAG applications must meet the leveraging ratio threshold of $2.5 of private funds for every $1 of UDAG funds. However, not all UDAG projects create permanent, direct new jobs. Neighborhood housing projects are an example of this type of project. Section 119(r) of the Statute ensures that such projects are not discriminated against. It would be difficult to assess the "ultimate costs" of such projects to the program since they have more indirect effects on development than do industrial and commerical projects.

SUBCOMMITTEE RECESS

Senator GARN. The subcommittee will stand in recess until Monday, May 7, at 10 a.m., at which time we will hear testimony from public witnesses. Thank you very much, Mr. Secretary.

The subcommittee is recessed.

[Whereupon, at 11:13 a.m. Tuesday, May 1, the subcommittee was recessed to reconvene at 10 a.m. Monday, May 7.]

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